

**Demonstrating the benefits of environmental
management systems in agriculture**

by

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B.Sc. (Hons), Dip. Ed.

**Submitted in fulfilment of the requirements for
the Degree of Doctor of Philosophy**

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Declaration of Originality

I declare that this thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by the way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of this thesis, nor does the thesis contain any material that infringes copyright.

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Genevieve Carruthers

04/02/2012

Statement of Authorship

I declare that the authorship of publications contained in this thesis is as follows (with institutional affiliations correct at the time of writing each paper):

Publication 1: Carruthers, G. (2003) *Adoption of Environmental Management Systems in Agriculture – Part 1: Case Studies from Australian and New Zealand Farms*, Publication No. 03/121, Canberra: Rural Industries Research and Development Corporation.

Authorship: Carruthers 100% (NSW Department of Primary Industries)

Publication 2: Carruthers, G. (2005) *Adoption of Environmental Management Systems in Agriculture: Analysis of 40 Case Studies*. Publication No. 05/032, Canberra: Rural Industries Research and Development Corporation.

Authorship: Carruthers 100% (NSW Department of Primary Industries)

Publication 3: Carruthers, G. and Tinning, G. (2003) Where, and how, do sustainability indicators fit into environmental management systems. *Australian Journal of Experimental Agriculture*, 43(3), 307-323.

Authorship: Carruthers 90% (NSW Dept of Primary Industries); Tinning 10% (NSW Dept of Primary Industries)

Publication 4: Carruthers, G. (2007) Using the EMS process as an integrative farm management tool. *Australian Journal of Experimental Agriculture*, 47 (3): 312-324.

Authorship: Carruthers, G. 100% authorship (NSW Dept of Primary Industries)

Publication 5: Carruthers, G. and Vanclay, F. (in submission) Using environmental management systems to promote adoption of innovations in primary industries and natural resource management. Submitted to *Journal of Environmental Management*, January 2011.

Authorship: Carruthers 65% (Ecosure), Vanclay 35% (University of Groningen)

Publication 6: Carruthers, G. and Vanclay, F. (2007) Enhancing the social content of environmental management systems in Australian agriculture. *International Journal of Agricultural Resources, Governance and Ecology*, 6(3): 326-340.

Authorship: Carruthers 65% (NSW Department of Primary Industries); Vanclay 35% (University of Tasmania).

An explanation of the role of each author is given in a preliminary statement prior to each publication contained within the thesis.

Signed:



Genevieve Carruthers

Dated: 04/02/2012

Statement of endorsement of claim by Supervisor:

As the primary supervisor of Genevieve Carruthers and as the co-author of two of the papers included in this thesis, I agree with the above stated proportions of work undertaken for each of the above published or submitted peer-reviewed manuscripts contributing to this thesis. I can further testify that I have received correspondence from Gavin Tinning indicating that he too is happy with the statements made by Genevieve Carruthers in relation to his contribution.



Dated: 11/11/2011

Principal Supervisor

Prof Frank Vanclay

Currently Professor and Head of Department of Cultural Geography, Faculty of Spatial Sciences, University of Groningen, Netherlands.

Formerly Professor of Rural Sociology, Tasmanian Institute of Agricultural Research, University of Tasmania, Australia.

Abstract

An environmental management system (EMS) is a management process designed to address systematically the environmental impacts of any entity. The process utilises a risk-based assessment of issues, focusing on continual improvement using data generated by the system. The best-known codification of EMS is the international Standard, ISO 14001. Ratified in 1996, and arguably applicable to any industry, this Standard was initially used in agriculture in 1997. This thesis considers the potential and actual outcomes of EMS use in agriculture. A multi-methods approach (involving case studies, document analysis, participant observation, reflection, and key informant interviews) was used to determine the benefits of EMS use and barriers to implementation. Firstly, 40 case studies of adoption of EMS by farmers were conducted to assess the applicability of EMS to the agricultural context. A subsequent study compared the outcomes, costs, benefits, behaviours and practices between 17 EMS users and 23 non-users. These studies indicated that EMS use conferred diverse benefits, and that EMS users differed in some ways to non-users. The benefits of EMS use were considered further, specifically the potential to assess outcomes using commonly recognised sustainability indicators, and for EMS to act as an integrative management tool. The implications of conceptualising EMS as an innovation and the role of elements of EMS in encouraging adoption of other innovations were then considered. Finally, the potential of EMS to promote social and cultural change was examined.

The research revealed that the EMS process was very useful to agriculture and easily implemented on-farm with minimal changes to the way in which EMS was typically applied. Using EMS provided farmers with a flexible tool to deal with a diverse range of intra- and extra-business considerations. Importantly, EMS gave a transparent and credible link to the information desired by natural resource management agencies. The EMS process enhanced and embedded innovation, while also being an innovation in itself. Most importantly, the EMS process strengthened change in social domains, leading to a culture shift in thinking about environmental and business management, increasing communications and interactions, and embedding and reinforcing change in practices. EMS use provided diverse outcomes

across the triple bottom line spectrum, providing a powerful mechanism to achieve policy, environmental, business and social outcomes. Despite the benefits of EMS use in agriculture, however, total adoption remains low. The use and applicability of EMS in agriculture could be greatly enhanced by clearer government policy and support. Other issues include clarity around the implementation of the various components of EMS, recognition of the scope and context in which the EMS process is used, mechanisms to encourage adoption, and the development of well-trained and knowledgeable EMS facilitators. Recommendations for addressing these issues are provided and implications of this thesis for future research are discussed.

Acknowledgements

I have been very fortunate to have the support of numerous people during this long, part-time journey towards a PhD. Without this support, I would not have been able to develop my understanding and experience with the topic.

To my husband, Phillip and children Aaron and Georgia – thanks for tolerating this extended project. Your support was absolutely crucial. To my parents – thanks for providing me the opportunity to study in the first place, and for promoting my interest in the environment (although probably not what Dad had in mind!). My thanks also to my good friend Caroline Reid for on-going discussions on juggling study, work, parenthood, and life and for numerous coffees (real and virtual).

My main supervisor, Frank Vanclay, has been instrumental in keeping me on track, and ensuring that this thesis was completed. His different ‘take’ on EMS, his depth of experience in the field of rural sociology and the social sciences generally, and his sheer perseverance in putting me on the spot meant that progress was made. Frank has gone out of his way to cope with a very distant student and identifying opportunities for me to participate in the academic world that as an off-campus student, I could not easily experience. Frank also expended considerable efforts in attempting to source funding for the proposed work. Dr Peter Slavich, Research Leader Soil & Organics Research, Industry and Investment NSW served as my co-supervisor and provided useful support in the early development stages of my research.

I tremendously admire and respect the farmers I have met over the past 15 years. Their intelligence, tenacity, and willingness to try a new approach was greatly appreciated. I thank them for allowing me to learn from them and work with them, to explore what an EMS can be, and how to best harness this tool. From Australia, Jim McDonald, Peter Jones, Mike Logan, Frank and Dianne Sciacca, Jenny O’Sullivan, Elaine Jones, Wesley Hazell, Ross Garsden; and from overseas, Jeff Wilson (Canada), Gary Jackson (US), and Tony Pexton (UK), all shaped my thinking about EMS and allowed me to see multiple possibilities for systems use in agriculture.

To the attendees of the inaugural 1999 EMS in Agriculture workshop – your involvement helped get EMS in Australian agriculture moving, and with many of you I took a great journey exploring this tool. The Rural Industries Research and Development Corporation (RIRDC) was the major supporter of this initial event, and provided valuable support for additional investigations – in particular, the case studies that form part of this thesis. Dr George Wilson, former manager of the Resilient Agriculture program at RIRDC, was one of the first RDC managers to recognise the potential of EMS. The then Land and Water Resources Research and Development Corporation provided funding for this workshop. The Grains Research and Development Corporation, and Meat and Livestock Australia were also early supporters for EMS research in Australian agriculture. Support from the Federal Department of Agriculture (in particular, Philippa Rowland and Dianne Deane), was vital in allowing EMS projects across Australia to see the light of day, and developing the early national approach to EMS. Special thanks also to Philippa for her long-term (and usually long-distance) friendship, encouragement and tolerance!

My employer for much of the time I was conducting the research (NSW Department of Agriculture /Department of Primary Industries) ventured away from the traditional ‘farming systems’ approach in 1998 when they employed me to work on EMS. In such a new field for agriculture, an experimental research approach was appropriate, and I combined research, policy, extension, and education endeavours to investigate the use of EMS on farms. Librarian *extraordinaire*, Jennifer Kirton, went above and beyond my expectations of assistance; tracking down a huge variety of papers – most outside the realms of the usual agricultural fare. She now probably knows more about EMS than any other agricultural librarian, and almost certainly, more than she ever wanted to! Many colleagues at NSW DPI also provided considerable support, including Liz Baker, Craig Copeland, Gavin Tinning Len Banks, and John Fisher.

My time as the EMS Principal Consultant at Ecosure allowed me to further my examination of EMS as a broad-reaching management tool for many situations, including airports, manufacturing, local government, and eco-tourism. It also led me to meet Cheryl Descha of Griffith University, who has provided support, understanding and assistance.

Thanks also to several influential EMS workers in the USA. John Shenot (Department of Natural Resources, Wisconsin) spent several months as an intern working with me at the Wollongbar site of NSW Agriculture. He went on to develop a large dairy EMS project as part of the Wisconsin 'Green Tier' development. Bob Stephens – Secretary for the United Nations Environment Program Best Practices Network (UNEP BPN), past-President of the Multi-State Working Group (MSWG) on EMS in the USA and formerly of the California Environment Protection Agency – invited me to participate as Australia's delegate in the formation of the UNEP BPN. This provided me with the opportunity to meet many people exploring the potential role of EMS as a public policy tool. Jennifer Smith Grubb (Director, Sustainable Silicon Valley and MSWG member), and Mark Loukides (Head of Site Operations, Johnson and Johnson) were extremely hospitable. They arranged for me to meet staff and managers of US organisations including: the Sustainable Silicon Valley group in the San Francisco area, the US Defence Department, Johnson and Johnson, the Californian Environment Protection Agency, San Diego municipality staff, San Diego Regional Sustainability Partnership members, winery and vineyard operators, agri-business representatives, and farmers. My participation in meetings with these people, and their associated networks, enhanced my understanding of EMS and my belief in its value as a management process.

A smaller group in the UK, Canada and Europe provided much-needed discussion and reflection. Tony Pexton OBE (former President of the UK NFU), Caroline Drummond (CEO, LEAF, UK), Ellen Wall (University of Guelph), and Gilles Grolleau (Université de Montpellier) all contributed in various ways to my thinking around the use of EMS in agriculture.

Thanks to the wider network of EMS workers across the globe that I have been lucky enough to find (I LOVE Google!). While most did not use EMS in agriculture, their EMS experience in other industries, and the sharing of this experience was very much appreciated. It was fantastic to find such groups at a time when there were none in Australia. The EMS Association in Australia, which was formed in 2006, was based to a large degree on these groups, and hopefully will do an equally good job in supporting EMS workers here.

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Preface

I came to my PhD research, which I started in 2003 (and which I have completed part time and as an external student), with a diverse background of educational and work experiences. These influences shaped the way I thought about the research topic, determined the approach I took, and affected my interpretation of the research. This preface provides a background to the development of my thinking about environmental management systems (EMS), and identifies some critical influences in my PhD journey which may be of interest and partly explains why this thesis is what it is.

My undergraduate degree focused on ecology and entomology. These subjects gave me an understanding of the importance of systems, connectedness, and the need to treat environmental outcomes as part of an entire package, rather than using a more traditional scientific reductionist approach. I developed an interest in integrated pest management, and realised that behaviour change amongst farmers and the service provision to facilitate such behaviour change was not straightforward. I also completed several psychology subjects in my undergraduate degree. These strengthened my interest in understanding motivations, behaviour change, and the influence that personality and attitudes have on practice change.

While I have no formal agricultural extension training (other than that developed ‘on-the-job’), I did train as a science teacher and taught high school and university classes in science, biology and pest management. I have also worked as a coach for recreational sport classes in several sports. These activities provided me with an understanding of the importance of personal motivation to drive practice change, the need to create the desire to learn and adapt, and the need to communicate and seek help from ‘experts’ when changes to routine practices are being made.

My interest in research and the academic process developed across a range of positions, including as a research fellow (at the University of New England), a project officer (at the Australian National University), and a professional officer (with the Australian Plague Locust Commission). These roles reinforced my desire to

work with practical aspects of sustainable agriculture, to apply rigorous scientific methods, and to assist farmers to adopt more sustainable practices.

Public policy influences on landholder behaviour was another significant factor. Employment with Federal and State agencies allowed me to experience the process of policy development and the importance of policy instruments in promoting practice change.

My first exposure to EMS occurred during my employment at the (then) Commonwealth Environment Protection Agency (CEPA), where I assessed the ecotoxicological effects of new chemicals. I had started with a 'Total Quality Management' approach in the assessments undertaken, without really being aware of this. The need for standardised procedures and processes became increasingly apparent, as did the need to deal fairly and transparently with all clients. At this time, CEPA also had a unit responsible for examining the use of EMS as part of a green procurement process. From staff in this unit, I had my first taste of EMS, and of the various policy measures used to influence EMS uptake. I began to appreciate the potential of such an approach in agriculture, and the environmental, financial, and social benefits possible from using an EMS process.

Fundamental policy changes were occurring at this time. Increasingly, agencies (mostly outside Australia, it must be noted) recognised that 'command and control' policy approaches were not achieving the desired changes in environmental behaviour, and alternative mechanisms such as partnerships or incentive programs were being explored. Landcare (an Australian farmer/conservation group partnership) was seeking a new direction. In particular, issues such as 'burn-out' amongst facilitators and farmers, and the need for validation of the outcomes of public expenditure on private lands had to be addressed. Catchment Management Boards were being reorganised, with a greater focus on local, on-ground action. A more global emphasis was created for agricultural markets, with free trade agreements, major export-driven marketing campaigns, and court cases regarding environmental claims becoming more common. Finally, a number of agricultural industries, in particular cotton, had begun to seek to turn around the negative images of their industry held by many in the general public. Agricultural industries were

engaging more in policy development, promotion of best management practices, training in their use, and media campaigns to promote the outcomes.

All of these influences came together in 1997, when I was employed by the then NSW Department of Agriculture as the Environmental Systems Specialist to spearhead the introduction of EMS in agriculture in NSW. This opportunity provided me with an array of linkages where I could draw on a range of my skills, and combined my interests in agriculture, sustainable natural resource management (NRM), teaching, and pesticide risk reduction. EMS was a very new concept for all businesses at this time, but particularly so for agriculture, which was only then starting to come to grips with quality assurance issues. My role included working with all agricultural industries across NSW, as well as researching international trends in the EMS arena. Diverse demands placed on farmers during this period included growing consumer interest in ‘green production’ with concurrent increased scepticism regarding ‘green marketing’, market access and trade considerations, and a general belief in the need for either intensification of farm management, or enhanced potential for niche marketing, in order to remain competitive. EMS seemed to offer numerous benefits for farmers seeking to address a range of such issues domestically and internationally.

There were very few EMS researchers in Australia at that time, and none, apart from me, focused on agriculture. There was no ‘EMS in agriculture network’, and outside of the Quality Society of Australia, very few options for systems thinkers to get together. As use of EMS in the manufacturing sector initially appeared to offer few parallels with the agricultural application of EMS (although I have subsequently changed my mind about this), I began to identify overseas programs that aimed to create directed changes in farmer behaviour. Three programs – the Ontario Environmental Farm Plan; the US Farm*A*Syst; and the UK Linking Environment and Farming (LEAF) program – all guided farmers through a self-assessment of the environmental issues on farm, and provided recommendations and best management practice advice to improve NRM outcomes. With funding provided by the Rural Industries Research and Development Corporation, I visited the chief protagonists of the US and Canadian programs, and supported travel by LEAF farmers and personnel to attend Australian meetings. These visits provided me with information regarding the establishment of broad-scale behavioural change programs amongst

farmers, and reinforced the need for EMS-related support and interactions, not only for EMS researchers but also for farmers seeking to adopt this approach.

A further key group I identified was the US-based Multi-State Working Group on EMS, whose conferences and meetings were a sanity-saver for me in my early DPI years. I have attended a number of MSWG events over the years. These provided me with a much-needed EMS network (albeit with no one initially working in agriculture), in which to test and challenge ideas about EMS development and implementation. Impressed with the knowledge exchange I witnessed through the MSWG, I began to create a similar network in Australia. This led to the 1999 EMS in Agriculture workshop held in Ballina NSW. Three key outcomes came from this workshop. The first was an agreed set of principles for EMS use in Australian agriculture. These ultimately formed the basis of the National Framework for EMS in Agriculture; a document accepted, but not fully promoted under the auspices of the Coalition of Australian Governments. Secondly, a clearly expressed desire for more information about EMS use, particularly the benefits that might accrue from its use on farm. Thirdly, and importantly for the on-going development of EMS in Australian agriculture, the workshop was the genesis of a network of EMS researchers, users and policy makers, biennial EMS in Agriculture conferences, and ultimately in 2006, the establishment of the EMS Association of Australia, of which I was elected inaugural President (a role I still hold).

My PhD research has resulted from the synthesis of these diverse influences. I initially wanted to investigate the changes in behaviours and attitudes that farmers might experience as a result of using the EMS process, which by its systematic nature should promote a traceable change that is the result of a thinking process. However, given the ‘newness’ of systems thinking to agriculture at the time, this was too ambitious. It became apparent that farmers and agency staff would not consider EMS as a viable and valuable management practice unless there was firm demonstration of the benefits arising from its use. Therefore, the study developed into an investigation of whether EMS use would indeed provide the policy, environmental and social outcomes that would justify its support by governments and industry groups. This resulted in changes to both my research questions and methodologies throughout the study. Due to my scientific background, my approach was initially positivist, which as defined by Bryman (2004) is the application of

natural science methods to the study of social reality and beyond. As the research developed, and as I became more exposed to rural sociology and other social sciences, my frameworks broadened.

Along with a major re-adjustment in my initial research direction, I continued to work full-time, while trying to complete my PhD. While difficult, this meant that I could maintain contact with a wide range of farmers using EMS, act as a participant/observer in situations that would not have been as accessible to a full-time student and remain involved in cross-agency EMS policy development. In order to obtain funding into EMS as a management tool, I also needed to demonstrate a clear link to the end-user, and my employment at NSW Agriculture facilitated such contact. However, my need to complete work obligations resulted in a 'stop-start' study pattern that was not conducive to a 'normal' PhD approach.

Further complications to this study came in the form of illness. About a year after enrolling in the PhD, I was diagnosed with cancer, which required six months treatment, followed by twelve months recuperation. I took a leave of absence from my studies for six months, but found it important as part of my treatment and recuperation to try to maintain some sort of 'normality' by continuing my studies as much as I could. In retrospect, my incapacity at this time meant that I not only missed a large part of the 'window' where funding was available for EMS research, but also meant that I was not as fit as I should have been to keep on top of full-time work and part-time study. In July 2011, my cancer was found to have returned, and I am again embarking on a prolonged round to treatments, and a very uncertain future. Other obstacles and difficulties I had to cope with throughout the course of my studies included changing jobs (from NSW Agriculture to Ecosure; and then from Ecosure to my own consultancy), and supporting my mother and family through the death of my father.

Getting to the completion stage has been a challenge. I considered withdrawing from my PhD on numerous occasions, but was driven onwards by several factors. Firstly, the continued support from my family, supervisors, and colleagues to keep going has been vital. Secondly, I really wanted to know just why and how farmers move through the EMS process, and what it is about the EMS process that helps this to occur. In order to help farmers become engaged in the process, the benefits of the

process needed to be demonstrated. Finally, I also wanted to learn how I could help assist prospective EMS users, and how to make the process easier. This thesis answers some of the questions I started with, but it has also created many, many more. I intend to continue in my quest to discover if there is something ‘special’ or different about EMS users, and if so, how this ‘specialness’ might be extended to others. I have been fortunate to work with very talented and dedicated people along the way, and look forward to continuing my EMS work with an expanded range of industries and management systems in my new role as an integrated management systems consultant in my own business.

Introduction: establishing the value of EMS to agriculture

Genevieve Carruthers
(written for this thesis)

The purpose of this introduction is to provide:

- an identification of the problems that the research seeks to address
- an articulation of the research question investigated by this PhD
- identification of the methods used to conduct this research
- an assessment of the contribution of this research to the field of environmental management
- a rationale for the selection of publications to be included
- an explication of the coherent line of argument that runs across the publications.

The references for this section appear at the end of the thesis in combination with those used in the concluding chapter.

Introduction: establishing the value of EMS to agriculture

1.0 Introduction

Growing awareness of the impacts of business management on communities, natural resources, habitats, and biodiversity has resulted in increasing pressure for business and government managers to use, promote and support enhanced natural resource management (NRM). At the same time, effective environmental and natural resource management is hindered by so-called ‘wicked problems’ (a concept introduced by Churchman 1967), where technological approaches must also address social issues to achieve effective solutions. In Australia, the Australian Public Service Commission (2007, p.14) defined wicked problems as those that “go beyond the capacity of any one organisation to understand and respond to, and where there is often disagreement about the causes of the problems and the best way to tackle them”. The management of natural resources for sustainable agricultural production is particularly beset by wicked problems, and farmers are at the forefront of dealing with these issues. Flexible, multiple and diverse solutions are required, which take into account the social context in which such problems occur. For example, Rittel and Webber (1973) posed 10 considerations of ‘wicked problems’ in the policy context and discussed the need for on-going iterative analysis of problems and the application of solutions – leading to the need for more knowledge-based and integrated management.

The need for integrated management to address complex business management situations (Deming 1986) has seen the use of systematic, integrated decision-making increase steadily in all business sectors (Andrews et al. 2001) including agriculture. This PhD is an exploration of the opportunities offered by the implementation of a specific management system process, as defined by the international Standard ISO 14001 and the Australian and New Zealand Standard, AS/NZS ISO 14001:2000 (Standards Australia 2004), to deal with the environmental impacts created in the agricultural production cycle, while simultaneously providing a valuable business management tool. In particular, this thesis investigates whether the use of EMS brings benefits to users and others. The research has focused on agriculture as a part of a larger ecological system, and addresses business management in the context of

environmental, social and policy issues. Accordingly, the research is of an interdisciplinary nature, both drawing on and contributing to a range of disciplines including environmental management, natural resource management, business management, rural sociology, human ecology, agricultural extension, and behavioural change. It specifically connects with the growing discourses of Environmental Management Systems, business and sustainable development, and corporate social responsibility.

Agricultural management is increasingly considered to be a complex interaction between the environment, natural resources, social, political and business considerations (Vanclay and Lawrence 1995). Authors such as Altieri (1987) and Pretty (1995) have discussed the need to re-introduce ecological principles into conventional agricultural management in order to address these complex issues, with Adger (2000) discussing the linkages between ecological and social resilience. Plummer et al. (2007) highlighted the links in agro-ecosystems between biotic and abiotic features, and social and economic factors. Vanclay and Lawrence (1995) and Vanclay (2004) both argue for greater inclusion of sociological considerations into agricultural management. Greater attention to the connections between the landscape, human interventions, socio-economic, governance and biological factors has led to the development of discourses such as agroecology (Altieri 1987), holistic resource management (Savory 1988) and landscape management (Teague 1996) and were discussed with regard to Australian agricultural management by Vanclay and Lawrence (1995). The implications of these developments for farm managers was captured by Ikerd (1993, p.155) who stated: "A farming system ... must be defined in terms of an overall approach to farming derived from a farmer's goals, values, knowledge, available technologies and opportunities, and is constructed by integrating a number of complementary farming methods". In addition, on-farm management must also address wider societal considerations as a way to appeal to consumers, maintain access to resources and the 'right to farm' (otherwise known as a 'social licence to operate'). Farming in Australia today thus requires the integration of an ever-increasing number of considerations into everyday management decisions.

Management systems developed as mechanisms to support integrated decision-making. These systems can be considered as collections of processes and procedures employed by an entity to ensure that its goals and objectives are met. Management

systems usually include elements to address risk assessment, planning, monitoring, training, communication, documentation, and to review achievements.

Environmental management systems (EMSs) focus on the management of environment impacts generated by an entity's operations. EMSs are gaining prominence as a tool for agriculture (along with other sectors) to improve NRM and landscape management. As much of Australia's land mass is under the management of farmers, encouraging them to use EMS is one means to gain better NRM outcomes, achieving not only business, but also public policy outcomes.

Gunningham (2007, p.310) described the potential of EMS for use in Australian agriculture thus:

EMSs could play an important role in enhancing risk management and building in continuous improvement, if they are used in combination with a number of other policy instruments. Where they include appropriate performance indicators/outcomes, accountability, transparency and consultation, where there are credible incentives to encourage their use and/or an effective regulatory underpinning, and where third parties are harnessed to contribute to policy goals, then they can not only lead to improved environmental performance but also, given their greater credibility in these circumstances, serve to protect agri-industry from international pressure for environmentally sustainable/healthy produce.

Consequently, governments and agricultural industries have invested in the investigation of the use of EMS in Australian agriculture.

Many farmers, farming industry groups, and agricultural and NRM agency staff, however, are often unaware of the EMS process, its use in agriculture, and/or the potential benefits that could occur from its implementation. In part, this is because most of the past work into the adoption of EMS centred on industrial, rather than agricultural, applications (Carruthers 2005; Gunningham 2007). Further, much of the work conducted on the use of EMS in agriculture has focused on whether EMS could be used on-farm at all. There has been little focus on the tool itself, or its utility as an instrument to induce changed behaviours. Relatively little examination has occurred of the impact of the process itself on the user (rather than the business or the environment), factors necessary to assist in adoption of EMS on-farm, and the economic and environmental outcomes that can be achieved. In addition, much of the information regarding the use of EMS on farms that does exist is often anecdotal material, rather than being available in the peer-reviewed literature. Finally, the

social impacts of EMS, both positive and negative, that might arise from its use in agriculture have not been widely studied.

A clear demonstration of the private and public benefits arising from EMS use on-farm should encourage uptake of EMS by farmers and lead to greater support from agencies to assist in EMS use, with growing recognition of the value of the process in achieving both business and public policy goals.

Many features of the EMS process are similar to the key elements required to develop effective environmental partnerships aimed to achieve improved environmental management (Gunningham and Sinclair 1999; Gunningham 2007). EMSs have been shown to be beneficial in numerous non-agricultural sectors, both internally for the business, and as a means to promote public policy goals. This was discussed by Mech et al. (2003, p.11) who stated that “globally, EMS has had a significant impact largely in non-agricultural sectors”, while noting that EMS application to agriculture has the potential to deliver environmental, operational efficiency and stakeholder management benefits. EMSs appear to meet many of the demands placed on businesses that are now required to demonstrate their environmental management credentials.

1.1 Thesis Structure

The major research question addressed by this thesis is **‘Does EMS use on farms produce benefits for the user, the public and the environment?’** A range of subordinate questions also consider the measurability of EMS benefits, relative advantages of EMS over other approaches, the potential for EMS use to achieve both business and public policy outcomes, and the possible practice changes stimulated by the use of EMS.

The **Introduction** draws on the published literature to initially consider the applicability of EMS in agriculture through an examination of the development of business management concepts, management systems and standards (particularly EMS), and an examination of how these factors led to the exploration of the use of EMS in Australian agriculture. It then discusses the research process undertaken, the major and subordinate research questions, methods used, phases of the research,

ethics approval, and examines the limitations of the study. Consideration is made of the characteristics of managers in general and of farmers as managers in particular, along with discussion of the drivers, possible benefits, and barriers to EMS implementation for business in general, and for agriculture as identified in the literature.

Six publications examining various aspects of EMS use in agriculture are provided (five already published and one now accepted for publication).

Publication 1 presents case studies of 17 farmers who were using EMS, and 23 who were addressing environmental management without the use of a systematic process.

Publication 2 is a further analysis of the case study results (from Publication 1), comparing and contrasting the two groups of farmers. Publications 1 and 2 identify a range of benefits arising from on-farm EMS implementation.

Publication 3 examines the measurability of EMS outcomes, and considers EMS as a tool to guide the selection and use of sustainability indicators.

Publication 4 considers EMS not only as a tool for integrating diverse management issues on-farm, but also as a mechanism to address requirements imposed from outside the farm, including those arising from quality assurance, customer, regulatory, animal welfare, and catchment management agency requirements. This publication highlights the added value that EMS can bring over and above the use of enterprise-specific management practices.

Publication 5 builds on the considerations in Publication 4, and considers the EMS process as an innovation, and a means to stimulate further adoption of other innovations.

Publication 6 examines the social outcomes that arise from EMS implementation on-farm. While social benefits of EMS use have been suggested in the past, these benefits have not received great attention (partly because they often are not the primary concern of the EMS researchers and EMS users; and also because they are often not easily measured). However, social considerations are the most likely to create lasting culture change and on-going EMS implementation.

Recommendations and Conclusions form the final chapter. This section provides a discussion of the benefits observed from EMS in agriculture in Australia, answers the research questions and highlights the implications of adoption of EMS in agriculture.

Due to the diverse issues potentially addressed in an EMS, this research covers a wide range of disciplines. This diversity reflects the complexity of managing an agricultural enterprise that gives full regard to the numerous environmental, social, and financial aspects influencing management. While initially conceived as a study predominantly of the extension requirements and capacity building surrounding EMS use amongst farmers, the research also examined the fields of NRM policy, farm and landscape management, micro-business management practice, farming styles and farmer typologies, and rural sociology generally. The thesis adds to the understanding of the benefits of, motivations and drivers for, and barriers to EMS adoption. This thesis is a contribution to the disciplines of environmental management, public policy development, small business management, social development for rural areas and agribusiness and farmer education, training and extension. The results provide data for use in the development of educational tools and extension material for farmers and agricultural extension agents, and information for use in future policy development to create a more enabling atmosphere to enhance farmer adoption of EMS.

2.0 Background to Environmental Management Systems

To determine the potential and actual benefits arising from the application of management systems approaches in agriculture, it was necessary to understand where and how the concept of management systems and related Standards arose. The following section examines changes in the concept of management, the emergence of systematic management thinking, and the development of management standards. The section concludes with a discussion of the growth of the use of EMS in Australian agriculture.

2.1 Evolving concepts of business management

In the past, production processes (for any product) essentially followed a relatively simple trail of product design/identification, product construction/building/growing, and then sale of the final product. Management was seen as the oversight of the production process only, often with little interaction with workers or customers. Goods were produced and any faulty product discarded at the end of the production process. Customers only became involved in the process at the point of sale.

A fundamental shift in thinking about manufacturing production occurred in the 1930s, when Shewhart (1939, p.44-45) suggested altering the common linear production process thinking (from specification to production to inspection) into *a cyclic process*, which he likened to steps in the scientific method (Shewhart 1939, pp.44 and 149). In part, this shift was caused by a move away from using resources to produce potentially faulty products (discarded at the end of the production process), to a more resource-conservative approach where quality aspects were considered at the inception of production. Building on this concept, Deming (1986) and Juran (Deming 1986; Powell 1995) worked with the Union of Japanese Scientists and Engineers to develop statistical quality control approaches that broadened the Shewhart cycle further, forming the basis of the 'Total Quality Management (TQM)' approach, and addressing a diverse range of management issues (Powell 1995). Deming (1993) initially described the fundamental steps for a TQM management system as the 'Plan, Do, Study, Act' cycle, which he described as the Shewhart cycle (Deming 1986, p.88). Crosby (1979) and Ishikawa (1985) were

other influential players in the development of the TQM concept and principles. On-going development of the TQM concept in Japan resulted in the description of the management cycle as 'Plan, Do, Check, Act' (Ishikawa 1985). Various steps, or principles, to achieve TQM have been outlined. Deming (1986) and Crosby (1979) both described 14 key principles of management or quality steps. Juran (1992) highlighted a trilogy of principles containing nine sub-steps, Powell himself (1995) distilled 12 key TQM principles, while Black and Porter (1996) claimed that there was no globally accepted, single model for the theory of TQM.

2.2 Management systems

Many of the features deemed as important to establishing a TQM approach address management practices such as risk assessment, planning, communication, training, documentation and collection and analysis of data. These features form part of an inter-related set of elements that together make up a management system. However, the importance of people in the overall development of robust and effective management systems was sometimes overlooked in the drive for efficiency of production. In their review of the origin and evolution of systems science, Flood and Carson (1993) described the transition of systems ideas and thinking from the early 1900s, from 'hard quantitative analysis' to a more integrative, 'soft qualitative approach'. They recognised the importance of social factors, and discussed the need for both process and people involvement in the development of systems.

Deming (1993: pp.50-51) described a system as:

a network of interdependent components that work together to try to accomplish the aim of the system. A system must have an aim. Without an aim, there is no system. The aim of the system must be clear to everyone in the system. The aim must include plans for the future. The aim is a value judgment. (We are of course talking here about a man-made system.)

Sheldon and Yoxon (1999) described a system as a way of moving data around an organisation, to enable informed decisions to be made regarding management, using data that the system itself generates, thereby ensuring that business-relevant data is applied to the management process. According to Brunckhorst (2005: p.9), a system is "characterised by strong, usually non-linear interactions and continuous feedback".

Maani and Cavana (2007; p.7, citing Ackoff 1999) described a system as “a collection of parts that interact with one another to function as a whole. However, a system is not the sum of its parts – it is the product of their interactions”. Maani and Cavana (2007, p.7) go on to state: “when a system is taken apart it loses its essential properties and so do the parts. When the engine is separated from the car, it loses its function and so does the car (i.e. motion). A system subsumes its parts and can itself be part of a larger system.”

Similarly, Ikerd (1993, p.147) noted with regard to sustainable agricultural systems:

Whole systems have qualities and characteristics that are not contained in their individual parts or components. The same set of components or parts may be rearranged spatially or sequentially resulting in a unique system or whole for each new arrangement. People increase their well-being by using information and knowledge to manage or rearrange the components of systems, resources, processes, and technologies in ways that enhance the productivity or 'well-being' of those systems.

Savory (1988) also stressed the need to be inclusive when developing the concept of ‘holistic management’ for agriculture. Thus, it is essential to recognise that a system works best when all of the integral parts can function together. The system will break down and not perform to its fullest capacity if certain parts, or elements, are left out.

Finally, the importance of systems as a part of ‘ecosystems thinking’ has permeated into (or even perhaps out of!) the science fiction genre, as exemplified by the following quote from Frank Herbert’s *Dune* (1965, p.570):

“A system! A system maintains a certain fluid stability that can be destroyed by a misstep in just one niche. A system has order, a flowing from point to point. If something dams that flow, order collapses. The untrained might miss that collapse until it was too late. That’s why the highest function of ecology is the understanding of consequences”.

Systematic management now draws on concepts in financial planning, human resource management, adult education, communication, and adaptive management, and has evolved to cover the full gamut of management operations.

2.3 Development of management system standards

As the concept of systems-based management grew, so too did the number of ways to describe the systems approach itself. Many countries developed their own standards to codify the required elements of a system. One of the better known approaches for quality management systems was the British Standard (BS) 5750, developed by the British Standards Institute and first published in 1979 (Tibor and Feldman 1996). The Standard was intended for general use by any business concerned with producing a consistent product suited to the purposes for which it was intended. Quality assurance took the idea of quality management from the 'end-of-pipe' inspection mechanism of quality control to a more systematic approach to the whole of the production system, and drew on business management practices to enhance the overall production process.

An important feature of having a consistent standard was that it allows a business's management systems to be assessed against the standard, and allows the display of a registration mark issued by the body carrying out the assessment of conformance to the Standard. A registration mark allows consumers to quickly identify which organisations and businesses are utilising a management systems approach, and it has been suggested that this recognition may confer a marketing benefit.

The BS 5750 Standard was adopted by the International Organisation for Standardisation (ISO) in 1987 as the basis for the international quality assurance Standards, now known as ISO 9001. Formerly, the ISO was more involved with the development of technical standards, and the ISO 9000 development process marked a transition into a greater focus on the process of management – reflecting the overall change within the business management community. Linkages between enhanced management and improved profits drove uptake of management systems in general and provided the impetus for greater ISO involvement. The ISO 9001 Standard were perceived to be suited for organisations and businesses delivering services as well as products, and in time came to be employed in government and other agencies as well. The ISO 9001 Standard was revised to enhance utility initially in 1994 with a major revision in 2000. Uptake of ISO 9001 approaches have been widespread and have steadily increased since the Standard was ratified in 1987 (Corbett and Kirsch

2001) with many businesses opting to implement a total quality management approach through the use of ISO 9000/9001 (Matias and Coelho 2002).

Over the last 50 years or so, there has been a gradual shift in business management from a focus solely on increasing production to greater attention on the act of management itself, and the influence that management can have on production levels. Increasing concern amongst the community about pollution, the environmental costs of production, and a demand for greater accountability for environmental stewardship resulted in pressure for business managers in all industries to examine their management practices and, in many cases, improve both the transparency and credibility of the actions taken in managing environmental issues. Larger companies and trade association began to develop pollution prevention programs, codes of environmental practices and resource use efficiency drives in the 1980s (Morrison et al. 2000; CEC 2005). At the same time, governments began to increase regulatory pressures in response to community and consumer concerns, often through application of licence fees, mandatory reporting, and increased oversight.

Following its successful uptake, ISO 9001 was examined to evaluate its potential application to management of environmental issues. The ISO evaluation committee decided that while the ISO 9001 model was useful for management systems in general, the required focus on environmental issues could not be achieved using this mechanism alone, and that a new Standard with better defined focus on environmental issues was needed (Tibor and Feldman 1996).

2.4 Environmental management systems

An EMS is “a formal set of policies and procedures that define how an organization will manage its potential impacts on the natural environmental and on the health and welfare of the people who depend on it” (Andrews et al. 2001; p.32). Nash and Ehrenfeld (2001, p.62) provide a similar definition, but emphasise “the structures of rules and resources” created through an EMS that assist in meeting environmental goals. Morrison (1999) described EMSs as cross-media (meaning water, waste, energy, air) approaches designed to integrate various business functions such as

accounting, procurement, product engineering and similar, with entire product systems (life cycles from resource extraction to manufacturing, use and disposal phases). He also highlighted that EMSs have potential to address non-regulated areas. Such areas have a great potential to provide cost-savings to EMS users.

Standardisation bodies in Canada, France, Ireland and South Africa all published EMS standards in 1992/1993 (Peglau and Baxter 2007). It was a British Standard, BS 7750 (released in 1992) that was largely used by ISO as the basis for an international EMS Standard (Quality Network, undated). BS 7750 addressed the development and implementation of environmental management systems and provided a greater focus on the environmental issues of production, services and activities, rather than attention to the final product.

The most widely used EMS process throughout the world is that of the ISO 14001 Standard, which provides the specifications for developing an EMS (ISO, undated). ISO Standards are developed through international collaboration by technical panels, and are revised periodically to improve their structure and utility. ISO 14001, which was ratified in 1996, provides specifications for the development and implementation of an EMS. In Australia, the ISO 14001 Standard was ratified verbatim as the Australian Standard, AS/NZS ISO 14001, in November 1996. The current version of ISO 14001 was revised in 2004, and therefore the Australian version of the Standard is correctly known as AS/NZS ISO 14001: 2004 (Standards Australia 2004a). For simplicity, in this thesis it will be referred to as ISO 14001. The Standard is supported by AS/NZS ISO 14004: 2004, which provides further guidance to the use of the ISO 14001 Standard (Standards Australia 2004b).

The Standard was developed to assist in meeting both internal and external outcomes for any entity. Additionally, Corbett and Kirsch (2000, p.8) state that rather than being an environmental standard, ISO 14001 is really a business management standard “intended to help certified firms integrate, gain control over and ultimately improve overall company-wide environmental performance”.

The overall aim of ISO 14001 is to support environmental protection and prevent pollution in harmony with socio-economic needs (BSI 1996). ISO 14001 “provides an explicit and closely documented procedural template for” an EMS “which can be audited and certified by an approved third-party” (Andrews et al. 2001, p.32). These

specifications are purposefully generic and it is important to note that ISO 14001 does not specify levels of environmental performance or outcomes. This would be impossible for a standard designed to be applied globally. Rather, the intent of the standard is to provide a framework to realise the entity's environmental policy through holistic and strategic supporting plans and actions, to assist in supporting compliance with legal and other obligations, and to establish a philosophy and practice of continual improvement. Continual improvement is a fundamental principle of the ISO 14001 Standard, and this concept was later also drawn into the ISO 9001 Standard through revisions. The focus on continual improvement, derived from changes to the system based on analysis of information generated by the system (a concept initially developed as part of TQM), is effectively applied through the EMS process (Anton et al. 2004).

The ISO 14001 framework specifies the elements needed for the development, implementation, and maintenance of an effective EMS, irrespective of the type or current environmental performance of the entity applying the elements. The Standard also creates a common language and vocabulary for communication between the entity and its stakeholders – whether these are staff, industry peers, regulators, customers/consumers, or members of the public. Related documents in the ISO 14000 series provide guidance for the development of an EMS, environmental performance evaluation, life cycle assessment, greenhouse gas accounting and verification (and requirements for accreditation of verifiers), environmental aspects of product design, communication, labelling, reporting. Auditing of EMSs is addressed as part of ISO 19011, which also covers quality auditing (ISO 2009a). Planned and upcoming components of the ISO 14000 series include principles and requirements for eco-efficiency assessments, guidelines for material-flow accounting, guidance for the conduct and reporting of carbon footprint analyses, guidelines for phased EMS implementation, eco-design, and for compiling and communicating quantitative environmental information (ISO 2009a).

The uptake of the ISO 14001 Standard has been even more dramatic than that of ISO 9001 (Corbett and Kirsch 2001). The most recent ISO certification figures (ISO 2009b) showed that worldwide, total certification to ISO 14001 numbered 223,149 in 159 countries in 2009. Total certifications to ISO 9001 were 1,064,785 in 179 countries for the same period. Growth in ISO 9001 certifications was 8% for the

2008-2009 interval while ISO 14001 certifications had grown by 18% worldwide in the same time frame. The ISO 9001 and the ISO 14001 Standards share a number of elements, and these have been built into newly developed management standards that deal with security, financial, occupational health and safety, and similar management areas.

3.0 The Potential Applicability of Environmental Management Systems to Agriculture

3.1 Factors leading to the consideration of EMS for Australian agriculture

The Australian community expects farmers to address the environmental impacts created by their own operations, in addition to the wider management of catchments and landscapes. One of the more widely used programs to address environmental issues on farm is Landcare. Many Australian farmers have been involved in Landcare, a concept developed and promoted by a coalition of farmer bodies and conservation groups in Australia. Lockie and Vancley (1997) provided a critical analysis of Landcare and highlighted the importance of enabling change through consideration of social issues. Carruthers and Tinning (2000) considered the potential of aligning EMS processes with the Landcare approach, and believed that this would build on existing community efforts to change farm management practices; a theme further developed by the Australian Landcare Management Systems Groups (ALMSG – see Gleeson 2006). The EMS process shares a number of features in common with the adaptive management process (Wilson et al. 2009), such as communication, monitoring and measurement, awareness and training. Other EMS elements (internal audit, management review, control of records and documents, competence, resources, roles, and responsibilities, nonconformity, corrective and preventive actions) serve to reinforce the management focus on data and information. A continual improvement focus is critical. The elements also link with Holistic Resource Management, and are essential for a reflexive/review approach. Modification of both behaviours and practices is based on the results gained from implementing the system. Vancley (2005, p.2) also highlighted certain parallels between the elements of both ISO 9001 and 14001, and features of social impact assessment (SIA), suggesting that SIA “should be a proactive stance to development to achieve better development outcomes, rather than being concerned simply with the identification and/or amelioration of negative or unintended outcomes”.

Consumers now expect (but will not always pay for) sustainable production practices and are increasingly sceptical of unsubstantiated ‘green’ claims about production practices. Farmers must take into account customer requirements for quality and food

safety, and public expectations of land management and increasingly use various management approaches to demonstrate their environmental stewardship. Farmers need to provide credible evidence of sustainable practices, and monitor and promote the environmental performance outcomes achieved. In order to do this, farmers need to assess and understand their impacts on the environment, prioritise their management actions in response, and determine the best actions to take to deal with the impacts. The ‘Plan, Do, Check, Act’ management cycle of ISO 14001 offers a structured framework to achieve these aims. Additionally, EMSs are compatible with industry-developed best management practices for environment issues where these exist, and on other ‘systems approaches’ for quality assurance, food safety, and to a lesser extent, occupational health and safety. These systems differ from the more conventional use of the term ‘farming systems’ which more often define specific crop rotations and enterprise specific actions aimed at increasing production.

Despite the general greening of expectations regarding land management, farming in Australia has often become more intensive, specialised and corporatized in response to economic pressures. A recurrent mantra for agriculture worldwide to drive increased production could be summarised as ‘get big or get out’ (see Plummer et al. 2007). Increased intensification of production requires a more intensive focus on management as discussed by Ridley (2007, p.367), who claimed that “To maintain living standards land managers must intensify production systems, purchase more land to achieve economies of scale, earn off-farm income and/or use higher management skills”. A need to increase the efficiency of production and reduce input costs could be added to Ridley’s list. A further feature of the intensification of production is that it also attracts much greater regulatory scrutiny than less intensive operations, as larger farms trigger levels of regulatory requirements, often determined by property size, stocking rates or waste disposal requirements.

Ikerd (1993) took a different view of agriculture. He called for a move away from ‘industrialised’ farming to “use farming systems that conserve resources, protect the environment, produce efficiently, compete commercially, and enhance the quality of life for farmers and society overall” (p.151) – overall, a more holistic approach. Rather than intensifying production, he believed that intensification of management was required to achieve sustainability. Ikerd outlined twelve characteristics of sustainable farming systems. Several of these characteristics are common to

principles of management systems generally, and feature as underlying principles of ISO 14001. These include being “management-intensive and knowledge dependent”; “individualistic and site specific”; dependent on “free-flowing information from multiple sources”; combining thinking and doing; and being reliant on “innovative arrangements of parts within whole systems” (pp.158-159).

In the drive for more sustainable practices, some farmers have chosen to narrow their target markets, and pursue niche marketing opportunities for ‘sustainable products’. For some, this has meant participation in organic or biodynamic production systems, appealing to consumers concerns about pesticides in foods and the impacts that farm inputs have on the environment. Certification and appropriate labelling of products then becomes an issue. Greater accountability must be provided for production practices and traceability of products. Again, the use of a management system assists by providing monitoring data, a focus on communication, and validation of management systems through certification processes. Additionally, many of Australia’s international agricultural competitors are starting to promote ‘green’ or stewardship behaviour towards agricultural land, and retailers now often require participation in a range of certified and validated ‘assurance schemes’ to gain market access (Gawron and Theuvsen 2009). There is a risk of loss of market share for Australian produce if such management practices are not employed.

While international standards are developing as a way of equalizing and facilitating world trade, there has been concern that rigorous applications of standards could lead to the development of non-tariff trade barriers. Another of the early stimuli for examining the application of management standards to agriculture was the potential to avoid such non-tariff trade barriers. Australia has a great reliance on export of agricultural produce, so such trade barriers can be a powerful incentive to alter behaviours across agricultural industries.

Another fear in the agricultural sector was that access to resources necessary for production (water, land tenure, and some inputs such as chemicals) would be restricted to those farmers who met stringent environmental requirements. Disquiet about the growth in environmental regulation stimulated some Australian agricultural industries to take firmer steps in setting their own agenda, by producing ‘best management practice’ manuals for a range of issues such as chemical use, irrigation

and food handling. Notable amongst the early movers to address chemical use was the cotton industry, which had attracted a great deal of negative comment about its use of aerially applied chemical crop treatments, and pollution incidents resulting in large fish kills.

In Australia, a number of factors thus drove the need for a more accountable and environmentally sustainable approach to agriculture. There was a need to “achieve behavioural change amongst a range of land users” (Australian Public Service Commission 2007, p.22). This created a growing recognition of the need to apply a more systematic approach to dealing with NRM issues in agriculture, as exemplified by Ikerd (1993, p.155) in the following quote: “Sustainable agriculture is fundamentally a systems approach to farm planning and decision making”. In response to these challenges, in 1997 the NSW Department of Agriculture appointed me as their first full-time (and as it turned out, only) staff member to examine EMS in agriculture. In March that year, only one farm was certified against the ISO 14001 Standard worldwide – an Australian cotton farm at Narrabri NSW. Four wineries in New Zealand subsequently developed a collaborative EMS approach to vineyard and winery management, becoming the first wineries in the world and the first agricultural group to gain certification in 1998 (Riddiford 1999). Since then, individuals and clusters of farmers around the world have developed and implemented ISO 14001-based EMSs (see Rowland 2006 and 2009 for summaries on the use of EMS in Australian agriculture).

3.2 Government initiatives in Australian agricultural EMS development

The first industry and Government-supported project in Australia to develop an EMS based entirely on ISO 14001 for a (grain) farm application commenced in 1998, conducted by NSW Agriculture (work by myself and Gavin Tinning) with funding from the Grains Research and Development Corporation (GRDC). In 1999 and 2000, two more grains industry projects followed, conducted respectively by the then Victoria Department of Primary Industries and by the Minginew–Irwin Group in Western Australia.

In 1999, with major funding from the Rural Industries Research and Development Corporation (RIRDC) and the Land and Water Resources Research and Development Corporation (LWRRDC), NSW Agriculture hosted the first national meeting on EMS in agriculture held in Ballina, NSW (Carruthers and Tinning 1999). Other industry, agency, and certification bodies to support the workshop included:

- the Cotton Research and Development Corporation (CRDC)
- the Queensland Fruit and Vegetable Growers (QFVGA)
- the Department of Agriculture, Fisheries and Forestry – Australia (AFFA)
- the Queensland Environmental Protection Agency (QEPA)
- the Primary Industries and Resources Department of South Australia
- the Murray-Darling Basin Commission
- NATA Training Services
- NATA Certification Services International
- Quality Assurance Services
- CSIRO Publishing.

Intended as an invitation-only event for 100 people, the workshop was attended by over 160 people, who discussed EMS issues over three days. Delegates represented a diverse range of Australian agricultural industries, government agencies, certification and consultancy bodies, non-government organisations and researchers.

Three key outcomes arose from the workshop. Firstly, the meeting concluded by drafting agreed principles to guide future development of EMS policy and research in Australia (Carruthers and Tinning 1999). Secondly, a strong desire was expressed by delegates for more information about who might use an EMS, how they might do this, and what they would get out of it called for the development of case studies on the use of EMS in agriculture. NSW Agriculture successfully applied for funding to conduct these case studies, with RIRDC funds awarded in early 2000. Thirdly, this workshop laid the foundations for an on-going network of researchers, policy analysts, farmers, and others to assess and evaluate the use of EMS in agriculture. Over time this network developed into the EMS Association, formed in 2006.

In 2000, the Federal Australian government took up the principles agreed at the 1999 meeting. An EMS Working Group was established in May 2000 under the auspices

of the Sustainable Land and Water Resources Management Committee of the Standing Committee of Agricultural Resource Management. This Working Group was to consider mechanisms to advance adoption of EMS and to maximise opportunities that arose from adoption (Hassall and Associates 2007a). The Murray-Darling Basin Commission had also begun to examine the use of EMS (see Andrew et al. 2007) recognising the need for better incorporation of farm-level performance targets into the management of the Basin area and catchment planning. The Environmental Stewardship Project involved four irrigation-based industries (cotton, dairy, wine, and rice) in the Murray-Darling Basin (Andrew et al. 2007).

The EMS Working Group, following consultation with agricultural departments, industry and agri-political groups, released a Public Discussion Paper “Towards a National Framework for the Development of Environmental Management Systems in Australia”, in November 2001 (EMSWG 2001). This document drew heavily on the principles agreed at the Ballina 1999 meeting, incorporating these into the Framework. The elements of ISO 14001 were also fundamental to this document (Quinn 2009). By this stage, several additional industry groups and their allied funding bodies (including Meat and Livestock Australia, the Horticultural Industries and Research Development Corporation, and Cotton Australia) had begun to fund research into the use of EMS, investigating how the process could combine with existing industry quality assurance and best management practice programs.

Further Federal funding was made available in July 2002, when the ‘EMS Incentives Program’ was launched. Farmers implementing an EMS could seek reimbursement of a maximum of \$3000 (based on spending at least \$6000). Incentive funds were only to be used for activities on-ground such as tree-planting, or in some cases monitoring, and did not cover costs associated with most capital works, gaining assistance for EMS development, or auditing/certification. The five-year program was administered through CentreLink (Australia’s social welfare agency) and originally specified that recipients of an incentive payment had to undertake EMS training. AFFA, in collaboration with Environment Australia, provided funding for NSW Agriculture to develop a National *Introduction to Environmental Management Systems in Agriculture* course (Carruthers 2003a), based on a course that had been run for farmers by NSW Agriculture for several years. Other States did not provide similar training programs however, and the requirement to attend EMS training was

removed from later requirements for the EMS Incentives program, due to constraints in the number of trained staff available to deliver such training.

Following consultation with industry and the community, the Natural Resource Management Ministerial Council endorsed “*Australia’s National Framework for EMS in Agriculture*” in October 2002 (SCNRMMC 2002). The importance of, and need for industry acceptance and support for EMS was recognised in this document, as was the need for consistency in approach to EMS across industry sectors. The potential for EMS to improve the management of both farm environmental risks and impacts was raised in this document. The need for compliance with the ISO 14001 Standard to guide EMS development was explicit in the Framework, along with the need to build on existing industry developments such as Best Management Practices and Codes of Practice.

Federal government support for EMS programs continued in 2003, with \$8.5 million of funding provided over three years to 16 EMS pilot projects, through the Natural Heritage Trust (Thomson et al. 2006). Specific objectives of this program were described by Hassall and Associates (2007a, p.1) as:

- to develop and assess the value of EMS as a management tool for natural resource management, from the enterprise to the catchment scale, and to:
- assist industry competitiveness and production efficiency; and/or
- assist primary producers to meet emerging market demands for quality and environment assurance).

These projects included eight that examined EMS application in specific industry groups (beef, lamb, dairying, cattle, rice, seafood, grains, and cotton) with other projects addressing either regional or multi-enterprise farm application of EMS. A significant policy shift in EMS funding took place in June 2003. Senator Judith Troeth, then Parliamentary Secretary for AFFA, hosted an ‘Environmental Assurance Think Tank’. The ‘*National Environmental Management Systems Implementation Plan*’ was developed and released at this time. This document suggested moving EMS to a ‘lower’ level approach, and that the process be broken into ‘tiers’, with a ISO 14001 certified EMS as the top level tier. Here, various agricultural industry and agri-political groups presented their views on the need for ‘environmental assurance’ to capture market benefit associated with enhanced environmental management, and on the need for greater industry ownership of related strategic programs. These views

moved away from a consistent approach across all agricultural enterprises, back to the industry-specific focus where more prescriptive (rather than process/ systems) approaches applied. Less emphasis was placed on the need for external validation and assessment of performance in this approach, with an increased focus on ‘adding-on’ environmental considerations to existing industry quality assurance approaches. The industry groups were advocating a move away from systematic, risk-based management to a prescriptive industry-by-industry best management practices approach. This led to the establishment of the “EMS Pathways” projects, formally announced in November 2003. However, the approach advocated by Australian industries did not reflect that advocated internationally (see Rocha and Brezet 1999; the EC 2001; Ardente et al. 2006), which all suggested that EMS, eco-labelling, and an Environmental Product Declaration scheme (EPD) be combined. Such schemes build on the EMS process to add elements of life cycle analysis to specific production processes, thereby enhancing the rigour and credibility of the EMS, and building in industry specific features. Such rigour and consistency was often lacking in the EMS Pathways projects.

The EMS Pathways program was to be a partnership approach between industry and government. Funding from the National Heritage Trust was provided directly to industry groups and their related research and development corporations (RDCs) to promote the adoption of sustainable farming practices in order to improve NRM and better market environmental stewardship to both farmers and consumers. This approach placed the onus on the industry groups to move ahead with environmental assurance programs. The focus shifted from the management of natural resources to supporting the adoption of increased usage of industry specific best management practice approaches – in effect, again moving away from systematic management. This meant that there was a shift away from the application of internationally recognised, standardised approaches to the management of environmental issues to a more industry and region specific approach, which did not effectively cater for multi-enterprise farms.

In July 2004, a new Industry EMS Advisory Group was established. This Group was to monitor the results of the Federal Government investment in EMS, and to oversee the EMS Pilots and Pathways Programs. The EMS Pathways projects funding was available in two parts. The first tranche (\$15,000) was provided to industry groups,

state farming organisations or their research and development funding bodies to hold workshops to develop their case for later funding applications. Workshops aimed to establish consensus on current activities for environmental assurance, determine future goals for environmental assurance, and establish a pathway to achieve these goals (Hassall and Associates 2007a). Coordination amongst specific industry groups was an expected element of this approach, and collaboration between groups was encouraged. Ultimately, eleven workshops were held, representing a mixture of industry and farmer organisations.

The second part of the EMS Pathways funding saw a total of \$12 million allocated across three rounds, two in 2004 and the third in 2005. An industry-based group assessed all applications. Nineteen applications were funded under this approach. The final round of the Pathways funding saw an increase in collaboration between industry groups (for example, a consortium formed from the grains, livestock and wool industries) and collaboration between industry and catchment groups (Hassall and Associates 2007a).

Federal funding for EMS research effectively became unavailable at the conclusion of the EMS Pathways program. On-going industry support has not been forthcoming for the use of systematic assessment and development of management. Instead, industry groups have moved to further develop a range of pre-existing quality assurance programs (aimed predominately at chemical management), and to enhance promotion of 'environmental assurance'. Quinn (2009, p.ix) stated "industry organisation-led approaches do not produce systems of the kind envisaged in the National Framework, but have been a major influence in the proliferation of systems leading to potentially limited usefulness of many of them". The concept of continual improvement, a fundamental principle of EMS, while espoused in some of these approaches, is rarely embedded through industry programs, as these often pay little attention to review, independent auditing, and assessment of management performance outcomes. Wells and Gallbraith (2000, p.329) sounded a note of caution with regard to not undergoing independent certification, noting that "certification to ISO 14001 is an even more effective means for a given Small to Medium Enterprise (SME) to improve environmental performance because certification necessitates sustained commitment to continual improvement". Gunningham (2007, p.305) noted "Neither codes of practice nor EMSs are likely to function effectively in the public

interest in the absence of adequate mechanisms ensuring accountability and transparency ... Where an enterprise self-monitors, there will be a temptation to misrepresent the results, providing an overly favourable account of its environmental performance, particularly if there are regulatory or public relations benefits to be gained from so doing". The shift in direction from independently scrutinised EMS approaches to industry assurance validated checklists has essentially meant that an opportunity has been lost for Australian farmers to not only enhance their NRM practices and gain recognition for doing so, but also to engage more broadly in the overall development of business management practices and outcomes.

The development of EMS in Australian agriculture therefore has moved from a government-advocated approach, focused strongly on consistency and risk-assessment via the use of international standards (a management-based regulation focus – see Gunningham and Sinclair 2009), to an industry-centric fragmented approach. This did not effectively address the needs of multi-enterprise farms, and usually did not adequately allow for external validation of claimed performance. In addition, the move to industry validation occurred despite recognition of the important role that EMS use can play in achieving public policy outcomes, an aim which should logically require more transparent scrutiny of outcomes achieved, particularly if public funds are used to support changes.

3.3 Use of EMS in Agriculture

My research focused on the ISO 14001 approach, as this Standard seemed to offer the greatest flexibility, credibility and international recognition, while also presenting a consistent approach that could not only apply to any type of farming enterprise, but would also (conceivably) mesh well up and down the supply chain.

EMS has been used in Australia agriculture since 1996; initially in the cotton, then the grains, and beef industries, with more concentrated use and evaluation occurring during the EMS Pilot studies and EMS pathways projects. These projects have been reported through the EMS in Agriculture Conference Proceedings (Carruthers and Tinning 1999; Carruthers 2002; PIRSA 2003; Department of Primary Industries 2005; TQA 2007), a special edition of the *Australian Journal of Experimental*

Agriculture (Vol 47 (3)), by Thomson et al. (2006) in their evaluations of the EMS Pilot projects, by Rowland (2006, 2009) and by Hassall and Associates (2007a; 2007b) for the EMS Pathways work.

The use of the British Standard 7750 (the prototype for ISO 14001) on nine farms, in an agricultural consultancy business and a farm/food processing business was reported by Anthony (1996). This study represents one of the earliest studies to examine the use of EMSs (but not the full ISO 14001 Standard) in the agricultural context. The project involved five training sessions where participants worked to develop awareness of all elements of the standard, assess on-farm environmental risks, develop environmental impact and legislation registers, and discuss the similarities and differences between their approach and on-farm quality assurance programs and the Linking Environment and Farming process. Issues identified by participating farmers included management, storage and handling of chemicals, resource inputs such as water and energy, and dealing with outputs such as plastic waste, manures and slurries.

Riddiford (1999), Fresner (2000), Knowles and Hill (2001), Walsdorff et al. (2003) have all discussed the use of EMSs (based on ISO 14001) in wineries in New Zealand, Austria and South Africa, respectively.

Bergstrom et al. (2000) examined an approach to combining ISO 9002 and ISO 14001 – this voluntary program operated through the Swedish Farm Assured program. The study reported a difference in the attitudes between smaller and larger farmer managers to the use of systematic processes for management.

Reith and Guidry (2003) and Lopes and Ferreira (2004) both reported on the outcomes of EMS adoption on government/University farms, where agricultural research and environmental research were being conducted. In both cases, the farms were utilised for multiple agricultural enterprises. In Reith and Guidry's case, the farm also serves as a research and education facility, and had residential dwellings.

Thirteen dairy farmers in the Tyrolean Alps area used the ISO 14001 Standard to guide the management of both their farms and eco-tourism ventures (Stern 2005; Peglau and Baxter 2007). While they were competing in the production of milk, they recognised the benefits of using the EMS process to work together to develop the

eco-tourism potential of the area, and to provide customer assurance that environmental issues were well managed on their farms.

EMS-like approaches investigated in the US included three livestock industries (poultry, beef, and dairy). The Partnership for Livestock Environmental Management Assessment Systems was a multi-state assessment of EMS and similar programs (Bird and Bushman 2005), which addressed similar questions to those raised in this thesis. As occurred in Australia, this program had to promote the understanding of EMS, develop farmer-friendly materials, and evaluate and compare approaches. Key questions raised in the program included whether EMS could support livestock producers to move to environmental sustainability, which EMS features worked best in the agricultural context, what elements of an educational/coaching program were needed for livestock producers, which policy innovations could support EMS adoption and what further research was needed. The program was evaluated from both the farmer and the stakeholder (government agencies, environmental groups, and agribusiness representatives) perspectives, using surveys and interviews to gain participants feedback.

Similarly, Schulman et al. (2000) discussed the use of the Ontario Environmental Farm Plan, Farm*A*Syst, the UK Linking Environment and Farming (LEAF) program (all EMS-like, but not ISO 14001-based), and the EnviroAg/North Otago Sustainable Land Management (which was based on ISO 14001), while Plummer et al. (2007) examined the Ontario EFP.

EMS has also been used in the horticultural industries. Corbett and Kirsch (2000) reported the use of ISO 14001 in banana plantations operated by Dole Food International in Costa Rica. Moomaw (2001) discussed an informal (i.e. neither fully documented nor certified) EMS used in a floriculture operation in Kenya (the Oserian Development Company, Ltd.) This farm employed over 5,500 people and implemented a range of environmental and social programs through its EMS. The CEC (2005, p.14) discussed a Canadian raspberry farm where, through an EMS, the use of pesticides was eliminated, synthetic fertilisers were replaced with composts, water use levels were maintained while production increased by 50 percent, and packaging, transport and storage costs were reduced. Overall, production costs declined with yields increased.

4.0 The research undertaken for this PhD

In developing EMS training and materials suitable for agriculture, it was inevitable that I became engaged in a research process. I needed to understand the EMS process myself, and to explore it in the agricultural context. I worked with farmers to understand EMS implementation from their (business owner) perspective, something very different to my own viewpoint as a researcher and EMS developer. I also needed to educate and work with other stakeholders to promote a policy culture conducive to EMS adoption and implementation. The first obvious manifestation of this approach was the 1999 workshop held in Ballina. The case studies that developed out of the 1999 Workshop increased my interest in the factors influencing EMS adoption in agriculture, and led to me embarking on my PhD research, which I started around 2003.

4.1 Research Questions

Before farmers contemplate EMS adoption, they want to know whether the EMS process will provide measurable benefits to the users. Thus, the primary research question for this PhD was **‘Does EMS use on farms produce benefits for the user, the public and the environment?’** Answering this question could provide a justification to encourage farmers to adopt EMS. An understanding of how to encourage and support adoption of EMS also required examination of a range of secondary questions, which included:

1. Is EMS relevant to the agricultural context?
2. Are the benefits of EMS measurable?
3. Do EMS benefits match, reflect, or exceed those gained through other natural resource management programs (e.g. Best Management Practices)?
4. Are EMS benefits limited to environmental matters and the individual only, or can use of EMS create public policy outcomes as well? Does EMS offer anything more as a policy tool to encourage changed practices?
5. Can the EMS process integrate with other requirements farmers need to address, such as quality assurance?

6. Does the EMS process enhance the management practices amongst farmers and increase their capacity to meet the challenges facing them? Does this capacity-building extend to other areas of their business management?
7. Do features of the EMS process itself encourage adoption? Are any of the ISO 14001 elements particularly important in creating change? Are modifications to the EMS process, as described by ISO 14001, necessary to enhance on-farm use?
8. What are the relative contributions of people, process, and policy to EMS adoption?
9. Does using the EMS process encourage practice, attitudinal and behavioural changes amongst users and support people? Do EMS users themselves recognise and report any changes in attitudes, behaviours, and practices with respect to farm and business management? Are EMS users in some way different to non-EMS users?

4.2 Methods

Given that I did not commence my role as the Environmental Systems Specialist at NSW Agriculture with a social science background, much of my early research was exploratory and not conducted in accordance with any particular theoretical (social science) framework. Over time, however, it became apparent that the social factors were a key ingredient for EMS adoption. Therefore, rural sociology offered an obvious discipline in which to base my research. In particular, I believed the concept of farming styles might help explain EMS adoption. My choice of Prof Frank Vanclay as my supervisor was influenced by his previous research into farming styles and farmer adoption of NRM practices.

Much of the research was conducted when the overall number of agricultural EMS users was a small (albeit expanding) population. Although I initially conceived of my work as solely quantitative, it soon became apparent that a blend of quantitative and qualitative analysis was necessary. Bryman (2004) discuss the pros and cons of such an approach, and Ashley and Boyd (2006) argue that a combination approach is particularly appropriate for research into environmental management. I adopted this

blended approach throughout all of the research projects, but increasingly with a greater emphasis on qualitative, rather than quantitative, methods and data.

I began my research with a comprehensive literature review. The pressures prompting management changes, particularly those in small businesses, required investigation, as did the skills and capacity of managers to undertake change. An understanding of the outcomes arising in non-agricultural applications of management processes was needed to identify the potential areas of benefit that might arise from on-farm application. Finally, an understanding was required of the barriers to the adoption of innovation in general, and of EMS specifically. Accordingly, I undertook an assessment of literature encompassing business management, standards development and application, factors motivating adoption of practice change, farming styles, rural sociology and agricultural extension.

All of the work was undertaken with a large degree of retrospectivity built into it, and I utilised a reflexive practitioner approach through much of the research. Throughout my research into EMS on-farm, I have immersed myself in as many different fora as possible, including EMS conferences, EMS standards development, auditing and certification procedures, EMS committees, research programs, and one-on-one EMS user interactions with farmers during research projects. These interactions provided the opportunity to work both as a reflexive practitioner and as a participant-observer. I was aware of my own values and biases towards various NRM practices, and of the impact that my influence had on the farmers and others I was working with. In the case of on-farm EMS mentoring, I took the approach of being a support person, rather than the 'expert'. In reality, the farmers were the experts in their management practices – I was able to provide support and suggestions to create an increased focus on environmental matters, and on the development of systems elements such as documentation, record keeping and monitoring.

An adaptive management approach was vital. Wilson et al. (2009, p.209) describe adaptive management as “a science-based structure for natural resource management” and state that adaptive management “brings a scientific approach to the management of complex biological, ecological, economical and social processes”. A feature of adaptive management is it continually adjusts to accommodate change in conditions, with changes occurring at any time. As EMS use

in agriculture was such a new area of investigation, when I commenced my employment with NSW Agriculture, a flexible approach, informed and modified as a result of findings from each project, was required. As new information, data, results, and outcomes were gathered continually throughout the early EMS application on farm, methods, and approaches needed to be altered correspondingly. Involvement of new industry sectors brought new information to light, sometimes almost daily. The ISO 14001 Standard itself is also subject to periodic review and these changes also required accommodation. Finally, data generated by each new EMS implementation provided me with new challenges and considerations, as each farm presented new and different management issues.

Action research was another method I employed. Bryman (2004, p.277) described action research as an approach where the “action researchers and a client collaborate in the diagnosis of a problem and in the development of a solution based on the diagnosis”. Flood and Carson (1993, p.48) observed that: “Action research provides the basis for an appropriate methodological approach for social situations. In essence, action research proposes that a researcher is involved in an action process and a change process. This approach underpins soft and critical systems thinking and methodologies”. As I was acting both as a researcher and as a change agent, the use of an action research approach was very appropriate.

While not aiming to develop new theoretical directions from my research, I also employed a range of tools from the grounded theory arena. Bryman (2004, p.540) defines grounded theory as “an approach to the analysis of qualitative data that aims to generate theory out of research data by achieving a close fit between the two”. Grounded theory is an iterative approach that fits well with the continual cycle of review and reflection inherent in an EMS. Coding of responses to case study questions and surveys, memo-ing, and constant comparison between EMS users and non-users were utilised in the case study work.

4.3 Phases of the research

Three major research projects have provided many of the insights described within this thesis. The case studies work (Publications 1 and 2) funded by RIRDC prompted my PhD enrolment, and provided the first evidence of EMS benefits for farmers. The GRDC-funded grains EMS project (DAN 390) led to Publication 3 and a consideration of how to evaluate those benefits. The NHT-funded dairy EMS pilot project (described in Publication 4) provided further opportunities to explore the use and expansion of EMS on-farm, and to consider mechanisms to improved EMS adoption. Publications 5 and 6 developed largely as a synthesis of the three previous projects, and from influences, discussions, and reflections arising from my routine as the Environmental Systems Specialist with NSW Agriculture. My research of EMS thus fell into four main phases. The boundaries between these phases are indistinct, and a great deal of iterative reflection and challenging of ideas occurred between them. These phases are outlined below and mirrored in the structure of the thesis.

Phase 1 of my research, starting with my appointment to NSW Agriculture, began prior to my PhD enrolment. My initial work was an exploration of the potential application of a new management process for use in agricultural enterprises. The initial focus was to assess if ISO 14001 could be used as a component of on-farm management to improve both natural resources and business management. In order to evaluate this, I extensively reviewed literature on current EMS usage, business and organisational theory, and on contemporary environmental management programs for agriculture. I discussed the use of EMS and similar programs in non-agricultural sectors with a range of researchers and extension staff, most of whom were not working in Australia, and researched the effectiveness of non-systems based approaches in Australian agriculture (such as Landcare). Key informant discussions were a major constituent of this Phase. Key informant interviews were conducted with R&D managers (specifically George Wilson of RIRDC, Martin Blumenthal of GRDC, Richard Bennett of HRDC, and Richard Price of LWRRDC), auditors during farm EMS audits, industry development officers, EMS consultants and researchers, certification and standards bodies staff, and agency staff. Again, common themes and areas of concern identified during these discussions contributed to the overall understanding about the issues surrounding EMS use on farm.

In Australia, a large part of my early work also aimed to raise awareness of the potential for EMS use in agriculture. This was achieved through the 1999 National EMS in Agriculture Workshop. Most of my time during this phase of my research was dedicated to raising the profile of EMS throughout the agricultural sector, and in alerting agency staff to a new area of application for the EMS process. During this phase, I also developed various tools and educational materials to extend the ISO 14001 concept into a farming context, including the initial version of the agriculture-specific national 'Introduction to EMS for Agriculture' training kit and video (funded by DAFF) (Carruthers 2003a). This work involved interaction with a number of stakeholders, and was informed by two surveys of farmers and state agency staff to determine the content areas and training needs for the development of an introduction to agriculture.

The background research, key information discussions, and outcomes of the 1999 Workshop led to the formulation of questions about the usefulness and benefits of EMS explored in the Case studies. A full description of the methodology for the case studies is given on pages xii-xiv of Publication 1, and pages 12-15 in Publication 2 (Carruthers 2003b; Carruthers 2005). In brief, 40 farmers were chosen from an initial pool of over 70 candidates regarded as innovative and environmentally focused, based on peer and agency staff recommendations. Of these, 17 were using an EMS process, while the remainder were using a variety of non-systematic management approaches. Detailed in-depth and semi-structured interviews were conducted to determine business structures, environmental issues covered by the farm management, farmer attitudes to business management and practices and their thoughts about the EMS process, drivers and anticipated benefits. Written notes and tape recordings captured interview responses. Responses from case study participants were tabulated, coded, and themes in responses identified. A comparison of responses between the EMS and non-EMS groups was conducted, identifying differences and similarities between the groups. The interview transcripts were developed into a case study format and are presented in Publication 1. No assessment or validation of the claims made by farmers were conducted during the interviews, as the focus was on individual farmer's thoughts and perceptions of the EMS process, not on quantification of claimed outcomes.

Phase 2 of my research built on the data compiled during the case study interviews, involving a more intensive analysis of farmer responses. Issues raised as part of the development of extension and training materials in the grains industry Project DAN 390 provided another important source of data in this Phase. The DAN 390 project was essentially an extension project, translating the requirements of ISO 14001 into a ‘farmer-friendly’ format, supplemented by the development of self-assessment materials for farmers to evaluate and benchmark their environmental performance, and templates to facilitate EMS development. This project led to two farmers undertaking an ISO 14001 certification audit, and provided an opportunity to incorporate and assess EMS knowledge present in the certification and auditing bodies into my reflection about ISO 1400. Factors influencing EMS adoption identified in the case studies analysis again surfaced in the grains research. This phase also incorporated an examination of the compatibility of the EMS process with monitoring and measuring sustainability indicators (Publication 3) as a means to measure the outcomes of EMS.

During this period, I engaged in the development of EMS policy (at both State and Federal agency level), contributed to a wide array of workshops, training programs, participated in EMS Pilot and Pathways project meetings, seminars, conferences, and inter-agency planning meetings, and commented on the development of Standards, the National Action Plan for EMS, and proposed EMS research applications. I attended several meetings and conferences with the Multi-State Working Group on EMS in the US, the UN Environment Program’s Best Practices Network, and provided advice to the Iowa Soybean Association on their EMS research and planning. During these events, I used both reflexive practitioner and participant observation methods to capture and assess various aspects of EMS implementation and the outcomes created.

I reported on the outcomes of the meetings to my seniors at NSW DPI, and these reports formed the basis for departmental contributions to State and Federal deliberations on EMS. Interaction with farmers adopting EMSs also occurred throughout my routine work for NSW DPI and these provided a range of opportunities to observe, question, and discuss farmers’ feelings and perceptions about EMS, and the benefits, costs and drawbacks of EMS implementation. The farmers included in the development of the training video effectively formed another

set of case studies, and included some farmers who were in the original case study work funded by RIRDC and several others who had not previously been interviewed about their EMS use. Some of the latter were EMS Pilot project participants, while others had independently developed EMS for their farming operations. The production of video material included discussions with over 20 farmers around Australia, representing grain, livestock, horticulture, aquaculture, wool, poultry, and mixed enterprise producers. Having established that EMS indeed provided measurable benefits in the agricultural context, and that the benefits extended beyond the farm business, I broadened my research focus to assess specific parallels for EMS use with business management theory.

Phase 3 represented a greater exploration of how to best use the EMS tool and whether any modifications were required to enhance the process. This phase included investigation of complementarities with other management processes, incentives, and public policy outcomes. Again, my contribution to, and attendance at conferences, planning meetings and project implementation provided numerous opportunities to canvass the views of farmers, industry groups and agency staff on the development and use of EMS in agriculture. Critical thinking about the specific elements of ISO 14001 and their capacity to integrate with other management process to promote changed practices occurred during the NHT-funded dairy pilot study, resulting in Paper 4. Consideration of the EMS process to promote the uptake of a range of innovative practices was explored, leading to the development of Publication 5. A further fundamental change observed in farmers using the EMS process prompted consideration of the capacity of EMS to promote social change, as described in Publication 6.

Phase 4 has been defined by my synthesis of information gained in the earlier phases into the conclusions presented in this thesis. It has involved consideration of potential improvements to the EMS process, use of policy to enhance adoption and additional factors that influenced current adoption trends of EMS in Australian agriculture. In this sense, Phase 4 ‘closes the loop’ and follows through the Plan, Do, Check, Act cycle, within the ‘Act’ area of EMS. This phase led to the next iteration of questions raised regarding the use of EMS in agriculture. This phase will continue beyond this thesis, and will be informed by EMS use in additional industry sectors, and on-going NRM policy developments and market requirements in Australia and overseas.

4.4 Ethics

All research conducted during my time at NSW DPI was covered by its departmental ethics reviews and quality assurance processes. During my formal PhD research, all data collection was undertaken with the approval of the University of Tasmania Ethics Committee (approval number H8067). This approval covered the administration of surveys and collection, collation and management of survey data. No ethical concerns were raised during the research period, and all annual ethics reports were satisfactorily completed throughout the period of candidature.

4.5 Limitations of this research

The research conducted during the case studies, the dairy and the grains research projects, and the data arising from that work upon which the papers presented in this PhD thesis all have their limitations that must be acknowledged as they potentially affect the conclusions drawn.

Firstly, information has come from a limited number of farmers. In the case studies this partly occurred because at the time the research was done, there were very few farmers anywhere in the world using EMS. The farmers included in the Australian and New Zealand case studies were the pioneers for agricultural use of EMS worldwide and, in that sense, could be thought of as virtually the entire population of EMS farmers at that time. Notwithstanding this, however, the data presented here cannot be used to draw statistical inferences. Over time, the number of EMS farmers has grown. My review of very diverse sources of literature for a broad range of industry sectors, as well as for farmer implementation of EMS (and EMS-like processes) in many countries, during the course of this PhD attempts to overcome this deficiency.

My research groups were a combination of a mixed sample of enterprise groups (the case studies) and industry specific groups (grains and dairy). Many concurrent research projects tended to focus on specific industry sectors, and in some cases, presented differing viewpoints about EMS benefits. Therefore, it is possible that my research did not adequately represent the views of any one industry sector over another, and that particular messages or issues from specific enterprise groups are masked.

Farmers included in the various studies agreed to be included and actively engaged in using a new process. It is assumed that they were, at least initially, receptive to the concept of EMS. Therefore the sample was biased towards farmers who could be presumed to have a positive view of EMS. The views of farmers who either withdrew at any early stage, or who did not continue to use EMS once the projects were completed, may not have been adequately represented by virtue of their withdrawal from the process. It was difficult to include information other than general observations for these participants. Therefore, more negative responses to EMS may not have been adequately captured. Again, inferences cannot be drawn to cover the whole farming population from the data collected. The establishment of matched groups of farmers, to include those who do and those who do not use EMS, and to follow their management over time would be helpful to eliminate this problem. This was partially done in the case studies (although the groups were not closely matched for enterprise or size of operations).

Much of the data presented in this thesis was self-reported by farmers, and not subjected to critical scrutiny of reported benefits and outcomes (although some participants undertook certification auditing). This research therefore will reflect self-assessment biases, and may not accurately reflect the real situation. Further, at the time of commencing EMS development, many farmers did not have comprehensive records of environmental performance against which to assess the outcomes of changed practices. Often, an EMS is implemented, in part, to generate such data. Therefore, this lack of baseline data makes it difficult to accurately measure progress in actual performance over time.

Finally, most of the EMSs examined throughout this study were not fully mature at the time of study. Many of the EMSs were still early in the implementation cycle, with almost all in operation for less than 12 months. Therefore, the evidence for outcomes had not accumulated to any large extent, and what was there related to the major first-stage changes of an EMS, not the longer-term benefits. While I have been able to follow some of the farmers through their EMS journey for some years, this has not been the case for all of them. The data presented in this thesis in some cases represented a single point in time for many of the farmer interactions. Therefore, the results, perceptions, and reported benefits represent a snapshot of the outcomes, rather than a longitudinal study. It was my intention to conduct a longitudinal study

for the PhD research, but due to a lack of funding and my health issues this was not possible. Therefore, it is desirable to compare initial reported benefits against those reported in other industries with a longer history of using EMS.

These limitations are not insurmountable, but should be addressed in any further studies along the same vein. Adequate funding to allow for longitudinal studies, the establishment of paired groups of EMS users and non-users, comprehensive pre- and post-EMS implementation assessment of performance and attitude, and industry-focused research are all factors that could assist in addressing these limitations.

5.0 Issues relating to the implementation of EMS

5.1 What is involved in management?

According to Karpin (1995, p.597) “The main functions of management are: planning, investigating, coordinating, evaluating, supervising, staffing, negotiation and representing ... and involves considerable information gathering ... problem solving and people skills”. Carlopio et al. (1997) contended that a core set of effective management skills exist, and while individuals may apply skills differently, the core attributes for performance stay the same. Managerial talent was described by Marchant (2003, p.56) as a critical organisational resource, and yet this talent is often unrecognised, even by managers themselves. Flood and Carson (1993, p.81) observed that: “Managers have to coordinate and control highly interrelated subsystems and weld these into a viable and effective structure”. Good management therefore requires a complex range of skills, and relies heavily on managers being able to synthesise and use diverse information. The following quote from Carlopio et al. (1997, p.xv) highlights the importance to management of having good information feedback loops, plus the need for reflections based on good data.

Effective management and effective learning can take place only when there is an understanding that errors need to occur in order to provide information that can lead to adjustments to future actions. Being wrong a few times is an essential part of the process of being right. It is important for risk-taking and initiative. Trusted feedback is the mechanism that supports and enables this principle.

The various aspects of management have a number of features in common with the fundamental EMS management cycle. Management systems help capture and build on management skills, through the process of gathering and using information, formalising processes and procedures, recognising gaps and risks, reviewing performance, and acting accordingly to address identified issues. Such management issues are also important in developing transparency and trust, two critical areas for gaining staff and management engagement in successful systems implementation (Gunningham and Sinclair 2009).

Numerous authors have discussed the management needs and issues of farmers. Marchant (2003, p.57) stressed the autonomous nature of farm management. Unlike a more corporate or industrial situation, farmers were described as “individually paced, have almost no supervision, and have very little structure imposed on their

daily routine” from outside the farm. The constant state of flux facing farmers across a range of issues was seen as a major driver for managers to increase their already large “repertoire of behaviours and skills to cope” (Marchant 2003, p.56).

In the shift to new management skills, managers will need to depart from the idea proposed by Taylor of breaking the whole management process into parts and dealing with each part separately (Grant 1979). Managers and farmers will need to understand the interactions, synergies and dynamics of their farm’s enterprises, and blend the smaller enterprises into an integrated operation. Such a course of action would require a shift in managers’ thinking from farming as work in a mechanistic, piecemeal fashion, as Taylor would have us think of work, to thinking of farming systems as a business and beyond the farm gate, to ways of organising knowledge not only about farm production, but also about global market issues, currency exchange rates, interest rates etc. (Marchant 2003, p.56)

Bitsch and Olynk (2007) studied the range of managerial skills recognised amongst pork and dairy farm managers in two US states. They identified that while intensification of agricultural practices was creating an increased need for managerial skills in farm managers (also noted by Ridley 2007), supervisory and managerial skills were often lacking in this group. Bitsch and Olynk used a focus group, grounded theory model to identify a typology of farm managers. They stated “livestock production management happens primarily in social interactions” and concluded that farmers seemed to be largely unaware of ‘brokering skills’, which are increasingly needed in more complex stakeholder relationships. However, they also claimed that agriculture presents a unique blending of management skills that does not often occur in other businesses. Anthony (1996) also noted that farmers, when compared to managers in other industries, generally face a greater diversity of environmental issues and impacts that they are routinely require to address.

Walter (1997) categorised US farmers into four major types: conservative, agrarian, steward and manager. Of these, ‘managers’ were admired for their record keeping skills (which were believed to ‘impress the bank managers’), and were seen as astute, analytical and strategic, bearing long-term goals in mind. Geno (1999) also recognised the perceived link between record keeping and commercial success as a belief in farmers. She noted however that many farmers still do not keep accounting records and documentation at the levels found in larger businesses – suggesting that while reporting good environmental progress might be acceptable to farmers, developing, using and maintaining systems-level data might not be. Good agricultural (and other) managers need to have, or be able to source, accurate and

timely information. Teague (1996, p.92) claimed that for rangelands “Nearly all ecological degradation has arisen from the failure to apply existing knowledge”. Ikerd (1993, p.159) also highlighted the importance of information for sustainable management, stating:

Sustainable farming systems are fundamentally knowledge-based systems of farming. Holistic management of the physical, biological, and financial components of farming systems, oriented toward a goal of long-term sustainability, may be a classic example of knowledge-based systems of resource development.

Many of the features of the EMS cycle thus not only meet the management needs of farmers, but also align with the characteristics of management farmers themselves said they desired (such as autonomous, flexible, and integrative). In particular, the social aspects of EMS (communication, training, and consultation) would appear to be critical elements often not addressed in other forms of suggested farm management, such as best management practices (BMPs) which tend to deal more with specific issues or environmental features. The utility of EMSs to generate and act upon knowledge generated by the system itself are important features. An EMS provides feedback loops, ensuring that data is captured for use in future decision making and provides the flexibility to deal with issues in a non-linear manner, a feature deemed important to both address ‘wicked problems’ and adequately include social considerations (Australian Public Service Commission 2007).

The development of business management skills for Australian farmers through training has been the focus of a number of programs and groups (for example, the Federal government’s Agriculture Advancing Australia initiative ‘FarmBiz’, Rural Skills Australia, the Rural Training Council of Australia and industry specific programs, see Andrew et al. 2005). However, most of these programs focused on specific issues, often promoted specific BMPs, and rarely addressed the development of more systematic management skills. Of 38 sustainable land management practices farmers might adopt identified by Cary et al. (2001), only six addressed systems elements such as scheduling, monitoring and testing. Other practices dealt with specific environmental issues and outcomes (for example fencing native vegetation to protect it from stock). Cary et al. (2001) acknowledged that application of the broad suite of management practices in isolation would do little to improve resource management, and they foreshadowed that more integrated planning and action was

required. The management process outlined in the EMS Standard, ISO 14001, provides such an integrated planning and management approach.

5.2 Drivers, motivations and supporting features for EMS adoption

The context in which a business operates will affect both the motivations to pursue EMS use in the first place and will influence the outcomes obtained (Emilsson et al. 2004; Vastag and Melnyk 2002). In addition, the drivers for initial EMS adoption and the intensity of use of the elements of the process are likely to change over time. For example, Alemagi et al. (2005) recognised four stages of an EMS process – planning (where the business has decided to do EMS, but is in the earliest phases); environmental review (where the business has started to recognise and identify impacts); implementation; and a certification phase. Accordingly, the drivers and the focus on specific elements of the system will vary throughout the process. Vastag and Melnyk (2002) observed that studies of EMS implementation done when EMS was a relatively new concept probably reflect a different set of motivations, expectations and outcomes than would be observed after the EMS had been in place for some time, when other businesses had become aware of it and started to use/demand it themselves.

The following section reviews some of the commonly reported drivers, influences and motivating factors for EMS adoption.

5.2.1 Economic factors

Economic considerations as key drivers for EMS adoption have been identified in many industry sectors (Miles et al. 1999; Florida 1999; Fresner 2000; Corbett and Kirsch 2000; CEC 2005). Cost cutting achieved from recycling or input reductions (Corbett and Kirsch 2000), can lead to increased profitability (Florida 1999), enhanced revenues (CEC 2005) and other economic benefits (Bird and Bushman 2005) as a consequence of EMS implementation. Improvement to overall business performance and efficiency (Florida 1999; Strachan et al. 2003) achieved by enhancement of internal business processes (Cassells et al. 2008) is another commonly reported outcome of EMS implementation.

Marketing considerations such as the prospect of gaining premium prices, market access, additional market share or other competitive advantage form further financial considerations for EMS adoption (see for example, Biondi et al. 2000; Corbett and Kirsch 2000; Gunningham 2002; and Strachan et al. 2003). An EMS can provide data on specific environmental outcomes for use in marketing, can assist in identifying market-focused environmental risks, and manage specific actions to deal with market-relevant environmental issues. However, Strachan et al. (2003) observed that over time, any market advantage from EMS use will diminish, as more and more businesses start to implement an EMS, and expectations grow that a business will have an ISO 14001 certified EMS, simply to remain in the market.

The use and number of certification schemes for agribusinesses is growing rapidly (Albersmeier et al. 2009; Gawron and Theuvsen 2009). In the past, these often had a focus on food safety and food quality, however, the recognition and reward for environmental management, as part of the overall 'quality picture' has recently grown. Gawron and Theuvsen (2009) in their discussion of the use of certification schemes in the European agri-food sector noted that certification acts as a 'quality signal' and can reduce buyer uncertainty regarding quality. In the same way, the use of EMS in agriculture is seen by many to assure consumers that environmental matters have been addressed, theoretically increasing the attractiveness of produce from farms with an EMS. Schulman et al. (2000) noted that the use of ISO 14001 (with its focus on record keeping and a whole-system approach) provided the capacity to implement a life-cycle auditing regime more easily. They believed that this would support the development of eco-labels and thus assist in product promotion and marketing. Anthony (1996) reported that customer pressure was a driver for the early UK attempts to implement EMS on farms. Marketing advantages specifically accruing to EMS adopters in agriculture have also been considered by Toyne et al. (2004), Cary et al. (2004), Twyford-Jones et al. (2005), Pahl et al. (2007), Sallur et al. (2007), Seymour et al. (2007) and Cassells et al. (2008).

ISO 14001 certification itself, however, does not provide a product labelling scheme. At present, there are few mechanisms that are well understood by consumers that allow for product differentiation for goods produced using an EMS. The distinction between EMS use and marketing goods was not made in the studies of Cary et al. (2004), Twyford-Jones et al. (2005) and Pahl (2007), who while nominally

investigating EMS adoption, in reality assessed the willingness of consumers to pay a premium for environmentally assured products. Thus, the outcomes of these studies reflect willingness to pay for 'green' goods, rather than willing to support management practice changes amongst farmers.

Market and/or customer location is another factor that appears to operate in the decision to adopt ISO 14001 (Anton et al. 2004) and is often related to market access. Several authors (Corbett and Kirsch 2000; Corbett and Kirsch 2001; Bansal and Hunter 2003; Potoski and Prakash 2004; Chang and Kristiansen 2006) all reported links between EMS certification and product destination and/or export market propensity. Mech et al. (2003) and Pahl et al. (2007) noted that Australian producers regarded the international recognition of ISO 14001 as an attractive feature in EMS adoption. Similarly, Knowles and Hill (2001) reported access to EU wine markets as a major driver for South African wineries engaging in EMS adoption. Anton et al. (2004) noted that 'firms that produce final goods and are in closer contact with consumers are likely to feel greater pressure or benefit more from improving their environmental friendliness', with Halkos and Evangelinos (2002) reporting a similar finding. However, Grolleau et al. (2007a) reported that customer location was only 'almost significant' as a factor in adoption decisions. For agriculture, it is likely that customer location could act in two ways. Long distance consumers are more likely to rely on credible verification processes such as certification to recognised standards to provide 'assurance' of sustainable practices, while local consumers are more likely to be interested in the 'green story' that an EMS can support and verify through assessment against stated objectives and targets, and monitoring data.

Another market consideration is that of maintaining EMS throughout the supply chain. Large customers (especially multi-national businesses and global corporations) may require their suppliers to implement an EMS as a way of management of the overall environmental impacts (Miles et al. 1999; Biondi et al. 2000) and corporate image of their business. This has been the case for businesses operating in Australia (Gunningham 2002), Mexico (Wells and Galbraith 2000), the UK (Hillary 1997; Strachan et al. 2003), the USA (Andrews et al. 2001; Florida and Davison 2001; Nash and Ehrenfeld 2001; Gunningham 2002) and Sweden (Ammenberg et al. 2000), amongst others. Corbett and Kirsch (2000, p.8) noted that

use of an EMS can be “a precondition for contractor bids to be considered” in both the USA and Canada for works commissioned by governments. Strachan et al. (2003), in their study of gas and oil companies in the UK, observed that use of ISO 14000 had become a de facto requirement for remaining in business. Anton et al. (2004) also noted the financial benefits that accrued from the potential to reduce future liabilities, often achieved through the reduction of risk factors (CEC 2005).

5.2.2 Peer pressure and industry stewardship

Adoption decisions have been reported to be influenced by peer pressure in some cases, in response to norms set by other firms in the same industry (Florida and Davison 2001; Nash and Ehrenfeld 2001; Grolleau et al. 2007a; Black 2010) or by co-located businesses (Ammenberg et al. 2000). The CEC (2005) and Grolleau et al. (2007a) reported that in some cases, use of EMS was a requirement of membership for various trade associations. Ammenberg et al. (2000), in their study of 30 SMEs in Sweden, observed that working with peers provided a cost-effective mechanism to develop, implement and maintain an EMS, and provided the basis for both business and environmental results in a wider area than could be achieved by individual businesses. Bird and Bushman (2005) reported the significant role that farm organization leadership can play in adoption of EMS and EMS-like programs.

5.2.3 Previous experience with management systems

Corbett and Kirsch (2000) also observed that previous use of ISO 9000 often meant that many of the systems elements for ISO 14001 had already been addressed, smoothing the development of an EMS. Corbett and Kirsch (2001), Vastag (2004), and Grolleau et al. (2007a) all reported that previous ISO 9001 certification was often a good predictor of ISO 14001 use and/or certification status. Vastag (2004, p.267) suggested in part this was due to a potential reduction in EMS establishment costs, as many of the elements of ISO 9001 are common to ISO 14001, providing “companies a relatively low-cost route to better corporate image”, thus providing a competitive advantage. Farmers who had previous experience with prior formal environmental management experience were more likely to use EMS (Bird and Bushman 2005). In contrast, Kirkland and Thompson (1999) and Grolleau and Thomas (2007) remarked that the commitment to EMS can wane over time, as individuals and businesses become aware of just what is required as they begin to

move through the process. Thus, it appears that, in some cases, previous systems experience may serve as an encouraging factor for EMS adoption, while in other circumstances, prior experience may act as a disincentive. It is likely that positive past experience and outcomes will encourage, and negative past experience discourage, EMS adoption.

5.2.4 Image, public relations and community interactions

For larger businesses, it appears that a desire to improve relationships with communities and regulators, and enhancement of reputation and ‘image’ of a business can be an important motivating factor in EMS adoption (Miles et al. 1999; Florida 1999; Florida and Davison 2001; Fresner 2000; Halkos and Evangelinos 2002), or in a financial institution context, principles-based regulation more generally (Black 2010). Cassells et al. (2008) attributed adoption decisions not only to an organisation’s desire to enhance their public image, but also to demonstrate conformity to society’s expectations regarding environmental performance. Improved public image is thought to lead to improved relationship with authorities (Corbett and Kirsch 2000; Nash and Ehrenfeld 2001) and with stakeholders (Miles et al. 1999; Strachan et al. 2003). With SMEs, and particularly farms, it is less clear how EMS adoption might influence community perceptions about the intention of an industry sector to behave sustainably, as the perceived overall impact of these businesses might be reasonably expected to be less than that of larger industrial businesses. In order to achieve positive public perceptions in the farming sector, it is conceivable that farmers in an industry group would need to both collectively adopt EMS *en masse*, and market such adoption widely to achieve industry benefit.

5.2.5 Communicating effective management

Modern businesses face ever-increasing scrutiny of their environmental and societal performance, with publicly listed firms needing more stringent and openly communicated environmental policies (Dasgupta et al. 1998), often leading to higher levels of ISO 14001 registrations in businesses with higher information disclosure requirements (Grolleau et al. 2007a). The increased scrutiny faced by financial institutions following the global financial crisis has similarly resulted in greater adoption of demonstrable principles-based regulation, typically based on industry

and government developed norms or principles of behaviour, coupled with more transparent scrutiny and reporting (Black 2010).

The ISO 14001 Standard highlights the need, not only for communication, but also for methods describing how communication is achieved internally and externally for the business, and with whom such communication will occur. Accordingly, EMSs have been described as important communication tools (Corbett and Kirsch 2000; Mech et al. 2003), allowing the user to systematically capture and formalise organisational knowledge, improving internal and external communication (Fresner 2000) and particularly suited to dealing with information from a diverse range of stakeholders and sources (Mech et al. 2003). These can include financial institutions, customers, and trade associations (CEC 2005; Cassells et al. 2008). Communication also assists in meeting staff concerns regarding management and assists in maintaining employee motivation (Florida 1999; Corbett and Kirsch 2000).

5.2.6 Meeting environmental goals

Florida (1999, p.8) found that a commitment to environmental improvement was the second highest motivating factors for business implementing an EMS, or adoption pollution prevention strategies. Corbett and Kirsch (2000) noted that EMSs are often used to gain control over, and improve, environmental performance, while Strachan et al. (2003) and Cassells et al. (2008) highlighted the importance of the expectation of improved environmental performance as an important driver for EMS adoption. The strength of this driver was also reportedly determined in part by the scale of poor past environmental outcomes (Anton et al. 2004) and by the need to manage recycling and/or waste disposal (Anthony 1996).

5.2.7 Regulatory pressure

Legislative compliance has been suggested as a factor motivating EMS adoption in many sectors (see for example, Dasgupta et al. 1998; Florida 1999; Biondi et al. 2000; Corbett and Kirsch 2000; Darnall et al. 2000; Andrews et al. 2001; Florida and Davison 2001; Welch et al. 2002, Griffin/Alexandra and Associates 2002; Gunningham 2000; 2002; 2007; Strachan et al. 2003; and Grolleau et al. 2007b). Cassells et al. (2008) stated that EMS use helped firms comply with regulations, and reduce the risk of an organisation or its officers being prosecuted for environmental incidents. In contrast, Halkos and Evangelinos (2002) reported that regulatory

pressure on businesses to improve their environmental performance did not encourage uptake of environmental management system standards. de Oliveira and Pinheiro (2009, p.883) highlighted that ISO 14001-based systems “do not substitute local legislation: they support it by demanding its complete fulfilment”. Gunningham (2007, p.305) also believed that EMSs would best be reinforced and underpinned by clear legislative requirements, and that EMS and other voluntary environmental management arrangements were “in almost all circumstances ... not a substitute for some form of external incentives or pressure, whether economic or in the form of regulation”. Gunningham and Sinclair (2009) noted a similar situation in the uptake occupational health and safety systems in the mining sector, where they advocated a mix of formal (i.e. regulatory) and informal systems be used to achieve better OH&S outcomes in the workplace.

For agriculture, Schulman et al. (2000), Ridley et al. (2001), Heisswolf et al. (2003), Carruthers (2003; 2005), Tee and Boland (2005) Pahl et al. (2007) and Seymour et al. (2007) have all noted regulatory compliance as a driver of EMS adoption. Griffin NRM Pty. Ltd. (2005) claimed that the use of EMS was the only property management planning approach that assisted farmers directly to meet their legislative obligation in Victoria and South Australia. They also noted that addressing legislative compliance could occur under several approaches in Tasmania and Western Australia, through the use of Farm Management Systems in Queensland, and in NSW, by use of both EMS and Property Vegetation Plans.

EMSs have also been described as important features in assisting businesses to move ‘beyond compliance’ (Darnall et al. 2000; Coglianese and Nash 2001; Cassells et al. 2008). Gunningham (2002) and Coglianese (2001) both suggested that publicly (by regulation or enforcement settlements) or privately (via supply chains) mandating EMS would increase adoption, although this was not without risk of increasing ‘tokenism’ in adoption. Additionally, Gunningham (2002) cited several examples of where implementation of an EMS either provided an amnesty from prosecution, or reduced punitive actions, claiming that such incentives could be effectively applied in particular circumstances. The potential for EMS to act as an alternative to increased government regulation was noted by farmers (Bird and Bushman 2005) as an attractive feature of EMS. Schulman et al. (2003), on the other hand, suggested

increasing penalties for environmental impacts through increased regulation could be an important driver for EMS adoption.

Coglianesi and Nash (2001, p.1) differentiate between public regulations, imposed on businesses from the outside, and EMS, which they described as “regulation from the inside”, where an EMS “represents a collection of internal efforts at policymaking, planning and implementation that yields benefits for the organization as well as potential benefits for society at large”.

Shareholder pressure and the impact of requirements levied by the insurance industry were raised by Rondinelli and Vastag (1996) as drivers for adoption of improved practices.

In addition to regulation, Gunningham (2007) recognised four other types of instrument that might encourage EMS adoption: economic, education and information, self-regulation and voluntarism. Gunningham and Sinclair (2002) discussed the potential for governments to move towards being facilitators of improved NRM rather than punitive regulators, concentrating on supply of education and awareness material. However, these authors recognised the difficulty in relying on voluntary instruments to achieve widespread practice change or to dramatically improve environmental outcomes (as did Mech and Young 2001 and Gunningham 2007).

Business enterprises are usually routinely required to undertake various inspections, audits, and/or mandatory reporting. The potential for relief from such scrutiny has been cited as a potential driver of EMS adoption, often using a ‘performance track’ approach to reward improved or superior behaviour (see for example, Brigden and Hjelm 2000; Coglianese and Nash 2001; Andrews et al. 2001; Gunningham 2002). Gunningham (2002) also noted that regulatory agencies usually have far too few resources to effectively inspect SMEs, and that a targeted and well publicised campaign of proposed inspections, along with the offering of alternative mechanisms such as self-inspections and audits to achieve improved environmental outcomes, may be more effective in stimulating uptake of EMS. However, it should be noted that Gunningham and Sinclair (2009, p. 872) sounded a note of caution regarding such oversight, indicating that careful use needed to be made of auditing, monitoring

and inspections so as not to disenfranchise workers, and create mistrust and suspicion between workers and managers.

In agriculture, the situation is different. The reality is that agricultural businesses simply are not subject to the same level of scrutiny that other industry sectors are. Gunningham (2007, p.303) stated that “in the early days, regulation of agriculture focused on the promotion and development of the industry, and even when environmental concerns were raised this did little to change the basic model of agricultural support rather than regulatory control”.

In Australia, the relatively remote location of many farms, the minimal (and declining) numbers of regulatory inspection staff available within agricultural and natural resources departments, and the focus that environmental protection agencies have on non-agricultural, point-source polluters, in effect means that Australian farms have never been heavily scrutinised in terms of environmental performance. The perception amongst farmers is often quite different, however, and there are always protests that farmers are being ‘regulated to death’, with an estimated 13-15% of farm profit being spent on dealing with bureaucratic ‘red tape’ annually (McEachern et al. 2007). Compliance drivers in agribusiness and agriculture have been considered by Anthony (1996), Yirridoe and Marett (2004), Bird and Bushman (2005), Gunningham (2007), Grolleau (2007b) and Seymour et al. (2007) amongst others. Pahl et al. (2007) observed a difference between drivers between intensive and extensive agriculture, suggesting compliance may be stronger for the former. Bird and Bushman (2005) also reported a difference in producer interest in EMS determined by fear of regulation. They observed that in states where regulation was considered a threat, there was greater interest in EMS, whereas other states saw greater participation in other programs.

5.2.8 Public Policy

Coglianese and Nash (2001), Coglianese (2001), Speir (2001), and Anton et al. (2004) have all examined the potential for public policy to be a key driver for EMS, and concluded that policy offers a range of opportunities for the promotion of EMS adoption. In selecting policy instruments (including EMS), Gunningham (2007, pp.305-309) recommended principles such as recognition of the importance of information, the inclusion of both improved environmental performance and the

means to monitor and measure this, the potential to combine with other instruments, and the need for a solid regulatory underpinning of any voluntary arrangements be considered. He suggest that these be combined with non-public sector resources (provided by commercial, non-commercial, and industry groups) and tailoring these combinations to specific environmental circumstances to achieve environmental goals.

Mech et al. (2003) recognised EMS as a voluntary instrument of environmental management, and saw this as complementary to regulatory instruments and market-based instruments. It was also noted that market based instruments have the potential to deliver multiple NRM outcomes beyond those mandated/regulated, and “may be more effective if complemented by PMP, EMS or FMS” (National Market Based Instrument Working Group 2005, p.4).

EMSs can also present conceptual difficulties for policy agencies. The following quote from the Australian Public Service Commission (2007, p.13) regarding the management of ‘wicked problems’ highlights the difficulty that government agencies have in dealing with EMS.

A traditional bureaucracy, divided into vertical silos, in which most of the authority for resolving problems rests at the top of the organisation, is not well-adapted to support the kinds of process necessary for addressing the complexity and ambiguity of wicked problems. Bureaucracies tend to be risk averse, and are intolerant of messy processes. They excel at managing issues with clear boundaries rather than ambiguous, complex issues that may require experimental and innovative approaches.

EMSs do not have clear boundaries when it comes to issues, interactions, and outcomes. They are flexible and by their nature designed to provide individualised outcomes. Therefore, Australian government agencies are not well set up to handle the promotion, assessment, evaluation, and policy development around EMS.

5.2.9 Provision of incentives

In some jurisdictions, businesses have received direct subsidies to support their EMS development and certification (Toffel 2000; Gunningham 2002). Allocation of public funds for conservation service provision, achieving preferred supplier status, grants, tax concessions and the use of ‘fast track’ provisions to gain preferred treatment for those adopting EMS were all incentives suggested by Gunningham (2007, p.306).

Pahl et al. (2007) found that financial incentives to adopt EMS formed a strong driver to initial engagement in EMS amongst pastoralists, with EMS cost-share payments also suggested by Bird and Bushman (2005). Seymour et al. (2006, p.2) also recognised the utility of EMS in providing “great accountability and transparency for incentive payments”, suggesting that government agencies would find the recording keeping and data generation required by the EMS process beneficial both when potentially allocating incentive payments and for State of the Environment reporting. However, Watts (2005) questioned whether EMSs could provide a sufficient level of environmental outcomes to warrant EMS implementation being used as a factor in allocating of ecosystem services payments. Mech et al. (2003) also discussed the distinction between delivery of ecosystem services and the use of EMS as a tool to document and communicate the business decision-making and use of various practices that may lead to delivery of ecosystems services. They suggested that verifiable performance standards for environmental outcomes are required or should be developed as the basis for ecosystems services payments.

One of key dangers of provision of financial incentives to promote adoption of EMS is that unless the EMS produces actual culture change within the organisation, leading to internalisation of changed practices, the use of EMS will last only as long as the funding does.

Gunningham (2002) reported on the low uptake of incentives offered by the UK Department of Environment’s Small Company Environment and Energy Management Assistance Scheme. In this case, up to 50 percent of the costs of implementation and consultants associated with the Eco-management and Audit Scheme were offered to small businesses throughout the UK. Only 136 businesses took up the opportunity over two years, which Gunningham claimed demonstrated the low capacity for SMEs to even engage in the use of EMSs.

Incentives can also be used to assist with external scrutiny and transparency through auditing and certification. A strong correlation has been reported between certification to ISO 14001 and provision of government subsidies (Wu et al. 2007). However, the impact of reduction in the subsidy provided for ISO 14001 development and implementation in Taiwanese firms in the period 1996-2004 was

less clear, with Wu et al. (2007, p.483) stating that their study did “not provide strong evidence to support the argument that government subsidies can increase firms’ incentive to become ISO 14001 certified”. Providing subsidies to support certification can reduce the actual costs but also share the risks. Governments and societies can gain through improved environmental outcomes and a reduction in environmental hazards as a result of businesses gaining certification to ISO 14001 (Wu et al. 2007, p.484), providing justification for subsidisation of EMS development and implementation, with certification providing the ‘acid test’ of implementation.

Schulman et al. (2003) claimed that in order to provide sufficient economic benefits through the use of EMS, either subsidies or other financial assistance should be provided to farmers. Alternatively, consumer demand could provide an incentive; although this needs to translate into more than simply demand for products – it must be matched with a willingness to pay more for these products (see Twyford-Jones et al. 2005).

5.2.10 Location and type of business

Jayasinghe-Mudalige et al. (2007) examined the impact of farm location in Canada on the adoption of various issues-based management plans (such as manure, chemicals, water, wildlife, grazing and nutrient management). Although strictly speaking these plans are not EMSs, they concluded that farmers are more likely to adopt plans, and to adopt more components of the plans, if farms are located closer to urban centres, and if there is a higher population close by. However, enterprise was a compounding factor with farms with grazing management plans and wildlife conservation plans more likely to be located further away from urban centres (by virtue of the requirements for larger areas of land for grazing enterprises). They attributed adoption in part to the social pressure placed on farmers – a factor that obviously is exacerbated by proximity to larger population centres, but also recognised that legal/regulatory and financial factors may also operate to influence adoption.

The size (Grolleau et al. 2007b) and type (Ridley 2001; Pahl et al. 2007) of farm is thought to influence EMS uptake. Similarly, farm ownership and business structure has also been postulated as an influential factor, with leasehold farmers potentially

more likely to adopt an EMS because of concerns about on-going access to farming land, and the need to demonstrate responsible management.

5.2.11 Personal desire to change

Use of EMS, certification, and participation in industry environmental codes of practice were described by Anton et al. (2004, p.633) as “internally motivated institutional change in corporate culture and management practices towards environmental self-regulation by incorporating environmental concerns in production decisions’. The need for underlying principles for a desire for change was succinctly stated by Sants (cited by Black 2010, p. 15): “A principles-based approach does not work with individuals who have no principles”. Florida (1999) noted that internal commitment to achieve improved environmental performance was a key EMS driver in some cases, to achieve corporate goals. Miles et al. (1999) noted that a desire for process innovation was a driver for EMS adoption. An EMS may help the best managers to do better, but may not be particularly effective at mobilizing the “bad actors” to take responsibility for their environmental impacts (Bird and Bushman 2005).

5.2.12 Personality, attitudes, and attributes of managers

While not often reported in the literature on EMS adoption, it is also possible that personality type also influences EMS use. Carlopio et al. (1997) discussed cognitive styles and associated information gathering processes used by Australian managers, relating these factors to management styles. Frost (2000) suggested that farmers who get involved in Landcare activities operate from a different set of values to farmer who do not and therefore EMS adoption may be influenced in a similar way.

McKeiver and Gadenne (2005) considered attitudes, beliefs, and characteristics of business managers as factors influencing EMS adoption, and Bird and Bushman (2005) reported links between personality factors and EMS adoption in American farmers. They noted that the producers who seemed to do best with the EMS process tended ‘to be reflective and comfortable with critical self-examination’, and as self-motivators, liked the aspect of individuality embodied in the EMS process. Shrapnel and Davie (2001) examined personality factors of Australian farmers in their assessment of the capacity of landholders to adopt ecologically sustainable practices, identifying five dominant personality styles (vigilant, conscientious, solitary, serious,

and sensitive) amongst farmers. Of these styles, some of the characteristics would seem to predispose farmers to adopt an EMS, while others would be assisted by EMS use. For example, conscientious types often cannot see the bigger picture because they focus too much on the detail. Therefore, the elements of EMS associated with clear risk assessment, issues identification, and setting of objectives and targets in a balanced and informed way can be of assistance for certain personality groups.

Gunningham (2002) claimed that the low eco-literacy common in many SME owners/operators prevents them from not only having little awareness of the environmental impacts they create, but also little knowledge of the solutions and benefits accruing from applying such solutions. This extended to a lack of knowledge about possible incentives or support programs. Kilpatrick et al. (1999) reported that learning to improve farm business efficiency, improving farm business viability, and acquisition of marketing information and skills all ranked higher than environmental awareness as motivations to engage in marketing or management learning. Legal compliance also ranked lowly as a motivator to engage in learning.

Gould et al. (1989) found better educated farmers were more likely to adopt conservation practices and Reeve and Black (1993) found better educated farmers had more favourable attitudes to using outside expertise in conservation practices. However, Reid et al. (1993) noted that the attitudes to getting involved in training amongst farmers depended on the stages of their career (lifecycle) that they were at (e.g. getting established, consolidation or preparing to retire).

Styles of farming (van der Ploeg 1993; 1994; Vanclay et al. 1998; Howden et al. 1998; Howden and Vanclay 2000; Thomson 2001) has been used as a methodology to examine farmers' perceptions of themselves as managers, in Australia and overseas. Whilst the methodology has some unresolved issues (see Vanclay et al. 2006), it is a useful tool on which to base an examination of farmer perceptions of their and other farmers' management approaches. While as yet largely unexplored, there may be distinct farming styles that influence EMS adoption, and it is possible that the early adopters of EMS may be different in their attitudes to business management practices.

5.3 Benefits of EMS adoption

Many authors do not distinguish between the use of an EMS in general, and the process of undertaking certification and auditing of an EMS. Therefore, the benefits arising described below can refer to EMS use alone, certification, or both. In addition, many studies report anticipated benefits, but few later validated whether these expectations were met. Where possible, and where authors made the distinction between EMS use alone and EMS use plus certification, or between anticipated and actual benefits, this is noted.

Often the design of an EMS will be influenced by the drivers and perceived benefits expected to accrue. This has also been noted in the case for agri-food certifications (Gawron and Theuvsen 2009). For example, an EMS designed to address a strict compliance regime will, at least initially, focus on meeting regulatory issues, and potentially deal less with building staff morale, strategic management planning and related issues. An EMS driven by the need for 'green marketing' and environmentally-conscious market access is more likely to be designed to tell the environmental story – so communication, validation of environmental outcomes and issues such as simple compliance to regulations, risk assessment and document control are likely to be less important. Benefits will therefore sometimes be influenced by the perception or reality of the drivers, the benefits that were 'looked for', and those that might have been 'predicted' by the influencers who suggested EMS implementation in the first place.

Hillary (2004) grouped EMS adoption benefits observed amongst SMEs into internal (organisational, financial and people) and external (commercial, environmental and communication) benefits. She also recognised that EMS benefits interact with other management issues such as quality and occupational health and safety. Of the benefits noted, Steger (2000) highlighted that many are intangible, and therefore difficult to measure. Vastag and Melnyk (2002, p.4744) noted two categories of benefits resulting from EMS implementation. Quantifiable or strategic benefits were those that reduced lead time, improved quality, reduced cost or otherwise enhanced the ability of the business to compete in its marketplace. Attitudinal benefits were less quantifiable, but resulted in greater awareness of environmental issues or opportunities for the business.

5.3.1 Improved environmental performance

Numerous authors have reported improved environmental performance and outcomes arising from EMS, with the particular issues often reflecting the initial bias of the study (e.g. studies aiming to examine the effect of EMS on pollution prevention found outcomes in this area; studies examining the use of EMS to reduce toxic inputs noted these outcomes). Businesses that implemented an EMS reportedly had superior environmental performance (Dasgupta et al. 1998; Briggs 2006; Cassells et al. 2008), with these results also providing an improved local environment (McKeiver and Gadenne 2005). Chavan (2005) and Cassells et al. (2008) also noted that EMS use enhanced the use of 'clean and green' operations, while Bird and Bushman (2005) and Seymour et al. (2006) reported generally improved environmental outcomes arising from EMS use on farms.

Improved performance relating to reduced emissions to air (particulate matter and noise), soils and water have been reported by Hillary (2004), the CEC (2005) and Briggs (2006), who found that benefits of EMS use included reductions in pollution, waste generation, and other negative environmental impacts. With reference to agriculture, Schulman et al. (2000) and Bird and Bushman (2005) reported farmers were better able to deal with manure and chemicals, and had a decreased impact on the environment as a result of EMS use.

Corbett and Kirsch (2000) reported that EMS use in industrial businesses enhanced the identification of wasteful or unnecessary use of heavy metals and CFCs, and in general created reduced reliance on toxic substances. Reductions in resources use (CEC 2005; Briggs 2006), in particular the use of water and energy (Chavan 2005; Cassells et al. 2008), are commonly reported EMS benefits. Alongside improved resource use, waste minimisation, improved waste management and an increase use of recycling are commonly reported EMS benefits (Hillary 2004; McKeiver and Gadenne 2005; CEC 2005; Cassells et al. 2008).

Environmental improvements were also identified as extending beyond the owner/manager of a business and outside the boundaries of the business implementing an EMS. Bird and Bushman (2005) reported a reduced risk to public health, while McKeiver and Gadenne (2005) noted that both a cleaner and safer working environment were outcomes of EMS use. Cassells et al. (2008) noted a

reduction in environmental risks and incidents, with Bird and Bushman (2005) attributing such risk reduction to improved management overall.

5.3.2 Focus on the business

It has been suggested that ISO 14001 provides a structured framework to effectively address environmental issues in a more strategic manner (Bridgen and Helm 2000, p.275) and aids in the development of stronger environmental objectives. The focus on the business may come about because the 'Plan, Do, Check, Act' cycle of EMS helps overcome the phenomenon of 'selective attention' (described by Schick and Vaughn 1995, p.57). The EMS management cycle encourages the collection and analysis of data to check outcomes of management choices, rather than relying on memory and perception of outcomes. The management cycle as described by ISO 14001 is focused strongly on issues specifically relevant for the business to address, as determined by the managers, informed by a situational analysis of the business. However, Bridgen and Hjelm (2000) also note that evaluation of environmental aspects and impacts is typically extended beyond the boundaries of the business implementing EMS, and often included not only suppliers and customers, but also the local (and sometimes wider) community. This means that a broader view of consideration of environmental impacts often occurs through EMS implementation and that further, that "decisions about ISO 14000 certifications go far beyond environmental considerations" (Vastag 2004, p.267).

5.3.3 Improved business performance

Nee and Wahid (2010) reported positive and significant relationships between EMS implementation and business performance. Gaining a greater understanding of how environmental conditions are affected by the business and improving operations to correct these impacts often results in greater business efficiency and effective operations (Chavan 2005). Strachan et al. (2003) recognised the importance of EMS in creating an increased awareness of both environmental impacts and environmental management to address these impacts. Biondi et al. (2000) reported organisational and managerial efficiencies. Wells and Galbraith (2000) discussed the use of EMSs as a tool to coordinate other environmental management tools. EMSs were also described as "a co-ordinating tool or as an engine that integrates and promotes environmental management" by Emilsson et al. (2004, p.146). The key determinants

of the intensity of organizational changes as a result of EMS implementation are EMS maturity, management involvement in the implementation process, and the prior existence of an ISO 9001 quality management system (López-Fernández and Serrano-Bedia 2007).

In a case study of one of the first US industrial facilities (an Alcoa aluminium reduction plant) to gain ISO 14001 certification, managers expected benefits such as reduced costs, elimination of incidents, development of new environmental solutions, improved maintenance, policy conformance, and a better ability to meet vendor requirements (Vastag and Melnyk 2002). Further anticipated benefits included increased production efficiency, conservation of inputs, regulatory relief, and ease of gaining permits.

Bergstrom et al. (2000) and Schulman et al. (2000) reported operational efficiencies arising from EMS use on-farm, with resulting cost-savings and enhanced performance, as did Seymour et al. (2006).

5.3.4 Business management and improved organisation

Evidence that EMS does promote organisational changes has also been found. López-Fernández and Serrano-Bedia (2007) studied 56 small companies in the Cantabria region of Spain, all with EMS implemented or being implemented. They examined the number of tasks done by individuals, the degree of control individuals had over their own jobs, formalisation of processes, specific job training and “indoctrination” (related to developing culture change and staff induction), employee training, availability of information about environmental issues, promotion of process, development of formal planning and control systems, development of linkages and the involvement in the decision making process. They also considered the age of the EMS, the level of training received to raise environmental awareness and the existence of previously implemented QA systems. They found that in all cases EMS implementation “triggers effects in all the organisations’ structural dimensions”. Chavan (2005) and Bird and Bushman (2005) reported that EMS use resulted in improved management skills, and better business management through the formalization of accountability structure and planning of operations. Similarly, Biondi et al. (2000), Hillary (2004), McKeiver and Gadenne (2005) and the CEC

(2005) all reported enhanced efficiency and lower costs, resulting from enhanced quality of organisational management.

Steger (2000) noted that use of EMS promoted more effective organisation and information flows within the business implementing the EMS. Corbett and Kirsch (2000) suggested that one of the benefits of ISO 14001 was that it helped spread responsibility for environmental management throughout a business. In doing so, various training benefits were capitalised upon. The EMS process was seen to “enforce rigour and control over functioning, but poorly coordinated activities” through formalising procedures and reducing reliance on one or two key individuals (Corbett and Kirsch 2000, p12). Environmental training across the board and assigning environmental tasks to general managers was seen by Dasgupta et al. (1998) as a more effective method to achieve change than using special environmental managers.

One of the first grain farmers in Australia to implement a certified EMS, Jim McDonald (featured in the Publication 1 of this thesis), responded to questions about whether he had found using an EMS restrictive (Alcorn 2002, p.15) as follows: “No, in a management time sense it’s not as onerous as I first thought...What we have found is our management has been a lot more disciplined than before”. Imposition of rigour and enhanced management is a commonly reported EMS benefit.

5.3.5 Enhancing existing practices

Many businesses that are not currently implementing an EMS may have some of the components in place. For example, many business have an environmental policy, either as part of a business plan, or as a stand-alone document. Assessment of compliance and operational control mechanisms may be in place. Communication with stakeholders inevitably takes place, even if it is not formalised. Alemagi et al. (2005) also observed this phenomenon, noting that businesses in industry groups that generally recognised a need for EMS were more likely to have a greater number of EMS components in place, even if they did not have a fully functional EMS.

EMS implementation serves not only to formalise existing arrangements, but also to create or enhance linkages between the various components so that overall functionality of management practices is achieved. Gunningham (2007) suggested

that the use of voluntary environmental management arrangements (including EMSs) were more likely to be preferred because they are flexible and allow users to draw on their own existing skills and presumably existing practices and arrangements; and therefore more likely to be seen as legitimate choices that will facilitate compliance.

Emilsson et al. (2004) claimed that the continual improvement focus of EMS provided continuity in environmental efforts and considerations. Consistency in approach is a further benefit. Continuity of approach is important when dealing with environmental issues, as the solutions are usually a long-term process, and likely to be interfered with by short-term political expediency. Therefore, an approach that elevates management and its reasoning/functioning outside the political arena is useful. The more formal and structured approach to engagement within EMS helps achieve these aims, and can help achieve political support.

5.3.6 Cost savings

Hillary (2004), McKeiver and Gadenne (2005), Chavan (2005), and Grolleau et al. (2007a) all reported increased profitability, or actual or anticipated costs savings arising from EMS use due to improved resource use and better workforce management, often linked to ISO 14001 certification. Chavan (2005) suggested that savings arising from EMS implementation would be at least 10 percent for many business operations. In some cases, EMS benefits have reportedly been achieved at low cost and yielded significant financial savings (Wells and Galbraith 2000). Hughes and Kemp (2000) made the distinction between adding /creating value by reducing costs or increasing revenue, and conserving and/or protecting value from future losses in their discussions about the financial benefits arising from EMS. However, Strachan et al. (2003) reported that companies they studied found it difficult to financially quantify benefits accruing from EMS implementation.

Minoli and Bell (2002) investigated the potential for EMSs to inform insurance brokers and underwriters, risk assessors and business managers as to the environmental risks posed by businesses, with a view to overall premium reductions and/or decreased risk profiles. The required management commitment to improved environmental performance, pollution prevention focus, risk assessment, and documentation and traceability were seen as positive features in preventing a pollution event. Similarly, many of the EMS features were believed to provide

benefits after a pollution event, including planning for addressing emergencies, reducing the charge of negligence and provision of information about the potential extent of damage. However, they also found that few insurance companies in the UK were engaged in providing comprehensive pollution insurance, and that there was poor knowledge and awareness overall about EMS, and so the potential benefits often were not realised. Schulman et al. (2000) presented evidence of discounts in insurance premiums of up to 20 percent being obtained by farmers who had completed all stages of the Farm*A*Syst program in the USA. This possible benefit from EMS implementation on Australian farms has so far received minimal attention, but there is considerable potential in this area, as Schulman et al. (2000) discussed. The EMS process is recognised as providing an 'early detection' system for adverse environmental impacts, as well as pre-empting emergency actions to redress pollution events. Thus, public good benefits are generated (through minimised pollution) even though clean-up actions may be a cost to individual businesses. Schulman et al. (2000) suggested that farmers using an EMS might therefore be in an arena of tradeable pollution rights; similar to the current carbon-trading discussions.

5.3.7 Improved ability to monitor performance

Bridgen and Hjelm (2000) suggested that one advantage of EMSs was that they promote the development of baseline data which provides the potential for improved benchmarking in the future, as well as informing management decisions. Bridgen and Hjelm (2000) claim that both the process of identifying environmental aspects and impacts and of establishing and monitoring progress towards targets results in improved environmental performance. Corbett and Kirsch (2000) also observed EMS use often prevents the incorrect or irregular calibration of environmental monitoring equipment, which can result in inaccurate monitoring. They suggested that this provided a mechanism to improve environmental performance. Lokkegaard (2001) examined the use of another part of the ISO 14000 series, ISO 14031, which focuses on the selection of performance measure indicators. He suggested that using ISO 14031 would assist in the streamlining of EMS development, particularly for smaller businesses.

5.3.8 Creation of culture change

Wells and Galbraith (2000) noted improved managerial staff attitudes to environmental issues arising from EMS use, which reportedly also filtered down to enhance employee engagement and pride in outcomes (Bridgen and Hjelm 2000). Hillary (2004) and the CEC (2005) noted the ‘people’ benefits of EMS including employee involvement, improved staff morale and general environmental awareness, which led to a change in the environmental attitudes within an organisation. Seymour et al. (2006) also reported community and social benefits outside the entity using an EMS.

5.3.9 Enhanced compliance with regulations

Steger (2000), McKeiver and Gadenne (2005), the CEC (2005), Briggs (2006), and Cassells et al. (2008) claimed that EMS use enhanced compliance overall, while Strachan et al. (2003) claimed EMS use decreased both the risk of, and actual, non-compliance. Schulman et al. (2000) also noted that use of EMS provided a method of communicating the use of industry self-regulation to external stakeholders, thereby reducing the potential for increase compliance monitoring. In their study, Bird and Bushman (2005) noted that by enhancing compliance (through increasing understanding, planning, and actual compliance), EMS use showed a ‘proactive face’ to regulators, reduced the risk of environmental liability, and lessened the chance of increased regulation. Similarly, Strachan et al. (2003, p.59) reported that use of EMS was not only a way to demonstrate compliance, but could also “influence future legislation”, while Seymour et al. (2006) stated that farmers saw EMS use as a way of ‘staying ahead of regulation’.

The monitoring of compliance and increased awareness of the requirements of regulations can both arise from EMS use (Biondi et al. 2000). Paradoxically, however, such monitoring can also suggest lower compliance amongst EMS users compared to non-users. This can come about through EMS users developing detection and reporting of environmental breaches, when compared to non-EMS users, who were not actively monitoring such breaches (Briggs 2006).

Dasgupta et al. (1998) suggested that EMS and pollution prevention programs promoted more effective environmental management and training, increasing the

elasticity of industry's response to regulation, and thereby providing very cost-effective complements to stricter enforcement.

Corbett and Kirsch (2000) reported that in certain jurisdictions, for example in Mexico, Brazil, the Netherlands and some prefectures of Japan, ISO 14001 certification was rewarded through 'relaxed' environmental surveillance or through issuing of single high-level permits rather than businesses having to apply for multiple permits. These authors also reported streamlined or faster permitting arrangements for ISO 14001 users, and noted that the documentation required for ISO 14001 also could be used to address much of the information required for permitting.

5.3.10 Marketing

Hillary (2004) reported on the competitive marketing advantages arising from EMS use and Chavan (2005) observed both the potential for market expansion and the ability to provide a more competitive product or service with EMS implementation. This potentially occurs due to improved relationships with customers (CEC 2005), brand image, recognition and promotion of market access (Schulman et al. 2000), and use of EMS as a marketing tool (Strachan et al. 2003). The 'EMS club' (Kollman and Prakash 2002; Potoski and Prakash 2005) creates a feeling of exclusivity, and yet it can be difficult and costly to maintain membership (Watson and Emery 2004). Bird and Bushman (2005) reported that a quarter of the farmers that they worked with on EMS believed that certification of their EMS as a positive step which could create market value, with 20 percent also believing that certification could raise public awareness, create recognition and credibility for the industry. However, some farmers only saw value in certification if either markets or regulations compelled it.

5.3.11 Communication and community interaction

Steger (2000), Strachan et al. (2003), Emilsson et al. (2004), and Wells and Galbraith (2000) all observed that EMSs provide both improved internal and external stakeholders communication, providing a common language between business operators and regulators. The importance of good information as a driver of practice change was emphasised by Stephens (1999, p.12) who stated that "quality information is the most powerful tool for producing change (internally and externally)" and "considerable improvement is possible on the quality of information

about environmental management and aspects” through the use of EMS. Similarly, Carlopio et al. (1997) highlighted the benefits of information as a means to empower managers, and claimed that information was one of the most crucial management tools possessed by managers.

An EMS helps organise and communicate information about environmental outcomes and changed practices (Schulman et al. 2000; Mech et al. 2003). Indeed, Vastag and Melnyk (2002) described ISO 14001 as the specification for the structure of an information system.

Grolleau et al. (2007a) and Schulman et al. (2000) both noted that EMS use provided enhanced stakeholder relationships. One possible reason for this was suggested by Mech et al. (2003) and Bird and Bushman (2005), both of whom noted that an EMS provided a mechanism to demonstrate responsible environmental risk management. Use of EMS also allows managers to manage environmental demands of diverse stakeholders, and to impose discipline on the way businesses use information in management systems, imposing a great accountability on data produced (Bird and Bushman 2005). Hillary (2004) claimed that EMSs provided communication benefits that assisted in the development of better customer relationships, while Bird and Bushman (2005) stated that such communication served to improve community and neighbour relationships. The improvement of image of a business through the use of EMS was raised by Biondi et al. (2000), Corbett and Kirsch (2000), Schulman et al. (2000), Strachan et al. (2003), Chavan (2005) and Cassells et al. (2008). Finally, Vastag (2004, p.267) noted that “It seems that decisions about ISO 14000 certifications go far beyond environmental considerations, and corporate image plays an important role in the certification decisions”, a claim supported at the firm-level by Rondinelli and Vastag (2000).

5.3.12 Achieving public good policy

Gunningham (2007) observed that policy instruments are more likely to produce positive attitude changes and improved environmental performance when they are perceived to be non-coercive. Therefore, the voluntary nature of EMS adoption should be viewed in a favourable light by those opposed to regulatory interference. Coglianese and Nash (2001) investigated the potential of EMS adoption as a means to achieve public policy outcomes, a theme also discussed by Schulman et al. (2000).

Ryan et al. (2010) noted that encouraging innovation was essential for enhanced NRM governance and NRM intervention, and suggested that greater connectivity was required between monitoring data, information, and knowledge. Greater accountability and regular reviews of progress were also required for actions taken to improve NRM. Thus, many of the elements necessary for good governance from a government perspective are also needed for good on-farm management. The EMS process provides these elements, enhancing linkages between targets, monitoring, indicators and actions taken.

5.4 Barriers to EMS adoption

Numerous studies have presented the barriers to EMS adoption. While some of the barriers are real, others reflect the misconceptions people hold about the use of management systems. For example, Corbett and Kirsch (2000, p.8) reported many business operators believe that only those with severe environmental problems would use an EMS; or alternatively believed that their own business in fact had no impact on the environment. In Corbett and Kirsch's (2000, p.6) terms, these misconceptions have in some instances become 'folk-lore', stating that "many of the firmly held beliefs about ISO 9000 and 14000 turn out to be myths". Babakri et al. (2003) also noted that in many cases, when business managers ranked barriers believed to inhibit EMS adoption, they did not rank any of the issues exceptionally highly, leading these authors to suggest that perceived barriers were in fact not major obstacles to EMS implementation at all. Many of the barriers to EMS discussed in the contemporary literature are similar to those suggested to prevent the uptake of quality assurance systems (Corbett and Kirsch 2000) and adoption of enhanced environmental practices generally amongst farmers (see Guerin and Guerin 1994; Vanclay and Lawrence 1995; Cary et al. 2002; and Pannell et al. 2006). In general, Hilary (2004) grouped disincentives for EMS adoption amongst SMEs as either internal (resources, understanding and perception, implementation, and attitudes and company culture) or external (certifiers/verifiers, economics, institutional weaknesses, and support and guidance) barriers. Factors inhibiting uptake of EMS amongst a range of industry sectors are further discussed below.

5.4.1 Size, type, and location of business

The intent of ISO 14001 standard is to be applicable to all organisations types and industry sectors, irrespective of their size or location (Starkey 2000; ISO 2009a). However, numerous studies have examined the difference between SMEs and larger businesses adopting EMS (see for example authors in Hillary 2000; Hillary 2004). The size of an enterprise can present a barrier to EMS adoption, with smaller businesses reportedly facing greater difficulties in adopting an EMS than larger enterprises (Florida 1999; Hillary 2000; Hillary 2004; Alemagi et al. 2005), and large plants in multi-plant firms also reportedly more likely to adopt policies that improve environmental performance than smaller businesses (Dasgupta et al. 1998). This barrier was partly believed to be due to the fact that “ISO 14001 and most other EMS models were designed by large companies for use by large companies” (Wells and Galbraith 2000, p.315). However, in their study, these authors ultimately concluded that EMS implementation is easier for SMEs than for larger companies. They believed this was due to SMEs having fewer overall environmental impacts to deal with, a lower level of corporate bureaucracy and ease of training and communication.

The internal capacity of a business to allocate resources to EMS adoption is also related to size. Smaller businesses do not have staff to dedicate solely to environmental management issues, and often have fewer monetary resources to either deal with environmental issues themselves, or to ‘buy-in’ the necessary resources (Florida 1999; Florida and Davison 2001).

Larger facilities are also reportedly more likely to seek ISO 14001 certification than smaller businesses (Christmann and Taylor 2001; Chan and Li 2001; Gunningham 2002; Grolleau et al. 2007a; Wu et al. 2007; Cassells et al. 2008). Chavan (2005) claimed that the benefits of having ISO 14001 certification are more readily realised by larger organisations as higher turnover means that certification costs are returned more quickly, whereas in SMEs, smaller turnover means that certification costs return a smaller proportion of benefits over a longer period. However, Babakri et al. (2004) also observed that smaller businesses may actually experience greater benefits in performance than larger firms following ISO 14001 certification.

EMSs are often perceived as tools for use by industrial businesses in developed countries (Alemagi et al. 2005). The use of EMS in developing countries compared

to developed nations was examined by Gallagher et al. (2004), Alemagi et al. (2005), Kerret (2008), Massoud et al. (2010), and Nee and Wahid (2010), amongst others. However, Rondinelli and Vastag (1996) claim that international standards such as ISO 14001 prevent businesses in developed countries from taking advantage of weaker environmental regulations in undeveloped nations (for example, by unscrupulous behaviour such as establishing or expanding businesses that engage in polluting behaviours, creating environmental impacts in undeveloped countries). Applying an EMS based on ISO 14001 in a multi-national business operation (theoretically at least) would mean that the level of environmental outcomes to be sought through the EMS would be that of the highest level demanded in all the countries of operation, not the lowest allowable level. Vastag (2004, p.261)) also claimed “industrialization and the level of development may also contribute to more environmental certifications because firms in more developed countries have the resources to absorb costs better than those in less developed ones”.

Businesses able to apply an ‘end-of-pipe’ solution to pollution issues are typically thought of as potential EMS users, particularly if governed by stricter regulation (Coglianese and Nash 2001). Certain industry sectors that are subject to more stringent regulations are also more typically thought to be EMS users, while primary production sectors such as farming, fishing and forestry have only more latterly been considered as areas of EMS implementation (despite their greater potential of such industries to affect much greater areas of land management).

5.4.2 Poor initial business organisation

Florida (1999) suggested that the initial organisational structure of a business may pose a barrier to EMS adoption. Poor structure or overly bureaucratic organisational features can both inhibit adoption and implementation. Instability of management and/or organisational structures and the isolation of an EMS implementer from key decision-making processes were also organisational features believed to inhibit or hinder EMS adoption (Hillary 1997). Gerstenfeld & Roberts (2000, p.115) claimed that environmental standards are ill-suited to SMEs because “standards are strategic approaches and SMEs don’t approach management strategically ... standards are generic and SMEs are specific” raising the possibility that lack of strategic action and planning within a business is a further barrier to EMS use.

Another business structure barrier to EMS adoption which is particularly pertinent, but not limited to agriculture, was highlighted by Reith and Guidry (2003) and Walsdorff et al. (2003) – that of poor record keeping. Poor record keeping on farms made it difficult to measure and set targets, to develop suitable metrics or to measure progress for many areas of management. Reith and Guidry noted that this occurs in all areas of operations, even those where good records might be expected (such as fuel usage, where there are strong financial drivers to keep such information, and where such records should be easily available). Walsdorff et al. (2003) also noted that the lack of suitable benchmarking data and agreed metrics in the South African wine industry were exacerbated by differences in business structures and enterprise mix. The poor ability to capture data in the first place was thought to arise from poor communication and support structures for data capture and review.

While a corporate structure can assist in EMS adoption, it can also serve as a barrier if the structure is not performing well. For farms in Australia, often run as family businesses, lack of resources can pose a particular barrier to EMS, but institutional barriers observed in larger businesses (such as communication and poor knowledge sharing) are not present. Walsdorff et al. (2003), Pahl et al. (2007), Sallur et al. (2007) and Seymour et al. (2007) all reported time and resources as barriers to EMS implementation on farms – common barriers to all SMEs.

5.4.3 Social and cultural barriers

Adoption of EMS can require, and promote, significant changes in behaviours, cultures, and attitudes amongst users (Hillary 2004; Babakri et al. 2003). Powell (1995, p.21) suggested in relation to adoption of total quality management (TQM) principles, that “innovations affecting core organizational features such as strategy, structure, and culture pose the most significant survival risks, and may produce resistance to adoption even if their expected values are positive”, while Hannan and Freeman (1984) discussed the influence of age, size, complexity of businesses on adoption of change. Gunningham and Sinclair (2009) additionally observed that the past history of industrial relations within a business (in their case, the mining sector) could influence uptake of OH&S systems, particularly where mistrust had been created between managers and workers. Similar reasons for resistance to adoption of EMSs, which are based on TQM principles, could be envisaged. Similarly, de

Olivera and Pinheiro (2009, p.885) suggested that “deep intervention” into an organisation’s culture was needed to successfully implement an EMS into a business.

Bird and Bushman (2005) also noted that the process-based approach of EMS is quite different to the best-management practice approach that many farmers have become familiar with (through extension programs, where they are advised to follow a set of practices; without assessing the risks faced, or analysing the potential outcomes of a range of solutions). They observed that EMS required different educational efforts, and that in order to generate farmer ownership of the EMS process, a steep EMS learning curve supported by a comprehensive educational program (for both farmers and educators) was required. Pahl et al. (2007) noted that farmers believed that once they had written down their plans that they had “done” EMS – they did not make the link between writing plans and putting them into action, and did not recognise the need for on-going implementation and review. Finally, Starkey (1998) stated that direct peer pressure sometimes acted to prevent adoption, with potential EMS users not wanting to ‘stand out from the crowd’ or draw undue attention to themselves.

5.4.4 Knowledge and Information

According to Gerstenfeld and Roberts (2000) and Gunningham (2002), many owners or managers of SMEs have low awareness of environmental legislation or of ‘eco-literacy’, leading to a low level of awareness of the impacts of their business on the environment, posing a barrier to EMS implementation (Hillary 2004). Low eco-literacy compounds the more general lack of knowledge of the EMS standard (Hillary 1997). In addition, many SME owners/managers have a limited understanding and perception of the benefits of EMS implementation (Gerstenfeld and Roberts 2000; Hillary 2004).

Gaining information about EMS benefits and appropriate methods to deal with environmental impacts can also be problematic. Anthony (1996) and Gerstenfeld and Roberts (2000) both highlighted the difficulties in locating practical and cost effective sector-specific solutions and relevant information on dealing with environmental issues. Provision of such assistance in-house for SMEs is not always available (Hillary (1997; Babakri et al. 2003), meaning that there are additional training requirements (Bird and Bushman 2005), a need for greater employee

involvement in the EMS process (Cassells et al. 2008), or a need for outside assistance. However, Hillary (2004) and Cassells et al. (2008) also noted a lack of support and guidance available from experienced consultants, those familiar with the needs of SMEs in EMS matters. In terms of agriculture, Pahl et al. (2007) observed that there was a lack of guidance, relevant information and other resources to use when trying to adopt EMS to on-farm use.

5.4.5 Difficulty interpreting the Standard

The language of ISO 14001 Standard can present challenges to managers. Watson and Emery (2004, p.923) reported that “The formal requirements of environmental management and auditing systems may be simultaneously too complicated and too vague”, and Ammenberg et al. (2000) argued that the ISO 14001 requirements are too difficult for small firms to interpret. In the agricultural context, both Bird and Bushman (2005) and Pahl et al. (2007) reported that the complexity and the terminology of the Standard inhibited producers from using the Standard to guide management. The relationship of the various elements of ISO 14001 to each other was also reportedly unclear for some, creating problems in seeing the need for all the stages of the process (Hillary 2004). Chavan (2005) went as far as to suggest that formal EMSs have merit as templates only, rather than as fully certifiable systems in the small firm.

5.4.6 Fear of paperwork

A reluctance to consider developing additional documentation, or increase the time spent on it, has been identified as an inhibitor to EMS adoption (Cassells et al. 2008), with SMEs rating this as a greater barrier to EMS implementation than larger businesses. Bird and Bushman (2005) reported that farmers, as kinesthetic learners and personalities, prefer doing to thinking, reading or writing, and therefore found EMS documentation cumbersome and tedious. This was especially true in states where producers had already met regulatory requirements. Geno (1999) discussed farmer attitudes to the use of documentation and accounting systems, stating that many farmers felt such actions were unnecessary, and detracted from time better spent in action on the farm. The paperwork barrier has also been examined by Corbett and Kirsch (2000) who reported that this area was often more a perceived problem than a ‘real’ one, once EMS users began to see the benefits of a functioning

EMS and associated paperwork. In addition, Geno (1999) reported that farmers in her study believed that it was important to keep records to demonstrate compliance, sustainability, and details effects of farming on the environment.

5.4.7 Lack of motivation or incentives

The lack of top management commitment can be a key barrier to EMS adoption (Hillary 2000; CEC 2005; Pahl et al. 2007; Cassells et al. 2008). This can be caused by a lack of interest in environmental matters (Hillary 1997), marginalisation of environmental issues from the core business of the firm (Hillary 1997; Babakri et al. 2003) or misperceptions about what is involved in adoption (Corbett and Kirsch 2000; Hillary 2000). The lack of motivation to adopt EMS amongst managers was also attributed in part to uncertainties about the benefit implementing the 14001 standard (Babakri et al. 2003), a lack of obvious rewards (Hillary 2004; Bird and Bushman 2005) and anticipated ‘disbenefits’ of adoption (Hillary 2004). Pahl et al. (2007) reported that farmers didn’t spend time on EMS unless prompted by researchers to do so. Wells and Galbraith (2000) also identified a need for on-going customer interest and support in addition to managerial input, particularly in the face of lax regulatory scrutiny and uncertain financial returns on environmental management investment.

5.4.8 Costs

EMSs requires resources both in the development and maintenance phases (Hillary 1997), with ‘human capital’ of staff time and skills also forming a cost component (Gerstenfeld and Roberts 2000; Hillary 2004). The CEC (2005) reported that such costs posed a barrier to EMS implementation for most businesses, with Geno (1999) highlighting the lack of money to make any changes as a particular barrier to EMS amongst Australian farmers. Reluctance amongst managers to divert funds from core business areas reflects commonly held management perceptions that the environment is an ‘add-on’, not usually considered as part of the routine business operations (Hillary 1997). In addition, maintenance of support for any EMS once commenced was reportedly subject to changing economic climates, which altered the priority given to EMSs in SMEs over time (Hillary 2004). The on-going resources required for sustained EMS implementation and costs of actions within the EMS added additional cost burdens (CEC 2005).

Gunningham (2002) and Carruthers (2005) noted that much of the cost of EMS development and implementation occurs early in the process, in the form of consultancy fees for advice and information for EMS development (Hillary 1997), whereas benefits accrue over a much longer time frame. Alternatively, Biondi et al. (2000) and Watson and Emery (2004) suggested that indirect and on-going costs arising from implementation presented a greater barrier than the initial start up costs of EMS use. These costs can include increased annual operating costs related to improved environmental practices. However, in their examination of perceptions relating to costs of certification of an EMS, Corbett and Kirsch (2000, p.8) observed that while it was initially believed by businesses that this would be a “major, resource-intensive undertaking”, many businesses “from small single-site operators to large multi-national companies on four continents reported no problems with the ISO 14000 certification process”. They further observed (p.13) that “while the cost of getting ISO 14000 certification is limited, the cost of not having it is likely to grow over time”.

Anton et al. (2004) claimed that the effects of EMS certification are greatest on businesses that initially had lower environmental performance. Halkos and Evangelinos (2002) also noted that this would result in greater costs of EMS implementation for businesses that had no management systems in place at all, when compared to businesses which already had some form of management system in place:

It is important to note, however, that the possibility of cost savings due to energy and raw material efficiency and waste minimisation programmes will be lower for those companies that had a well organised environmental management system in the past and vice versa. Thus companies with very inefficient management systems should expect high rewards for implementing EMSS but they will have to pay the price in terms of the high costs of implementation (Halkos and Evangelinos 2002, p.363).

Costs in time can also be a significant barrier (Anthony 1996; Babakri et al. 2003). The workload of EMS implementors (Hillary 1997) and lack of available resources in both small and larger businesses (Gunningham 2002; Bird and Bushman 2005) to devote to systems development and implementation can be major EMS inhibitors.

Costs over and above development and implementation expenditure can be incurred by businesses that choose to undertake EMS certification auditing (Babakri et al. 2003; Hillary 2004; Cassells et al. 2008). Such costs do not often arise from

implementation of best management practices, although these programs can require significant capital expenditure in some cases.

Finally, Hillary (2004) suggested that the difficulty experienced by many businesses in identifying the environmental performance expectations of different stakeholders could also form an inhibitory factor for EMS adoption. Considerable resources can be expended in undertaking the research needed to identify the expectations of external parties.

5.4.9 Lack of support through the market chain

A further, significant barrier to EMS as applied in agriculture is the generally poor awareness of the process by 'down-stream' stakeholders – transporters, commodity agents, food processors, retailers, and consumers. It is highly unlikely that a price premium will be provided, or that demand for EMS will be explicitly stated by these groups, if they are not even aware that the process exists. Gunningham (2007) suggested that many overseas consumers are unlikely to be concerned with Australian environmental issues, and therefore not likely to be supportive of paying higher prices for Australian agricultural produce based on environmental stewardship.

5.4.10 Measurability of benefits

It can take a considerable time for EMS benefits to become recognised. Powell (1995) suggested that three years was a common time period for the production of consistent performance advantages to become evident, as this period is needed for changes to management to be adapted to, assimilated and stabilised. Hillary (2004) observed amongst many small business operators that a perception exists that paperwork is emphasised over environmental performance, and that the focus was therefore often not on recording or appreciating outcomes when they occurred, but rather on documentation.

Gunningham (2002) and Cassells et al. (2008) observed that the ability to perceive changes to outcomes also takes time to develop. A system must mature and work for an interval before the implementation of planned changes produces results. Further, depending on the previous degree of systemic failure, the time prior to results being observable will differ. The inclusion of monitoring and measurement requirements

within an EMS is an important factor in capturing the results of change, and yet often the need for these requirements are not often fully understood or appreciated at the outset of EMS implementation.

A specific agriculturally-related barrier to EMS adoption was noted by Walsdorff et al. (2003), when they observed that lack of suitable benchmark data made it difficult for agricultural enterprises (in this case wineries) to evaluate their own level of environmental performance, and to set realistic targets. An inability to be able to compare within the same industry sector and lack of data management and data capture abilities and skills should also be noted as an EMS barrier. Babakri et al. (2003) also noted that a lack of easily recognised environmental performance improvement meant it was difficult for EMS users to demonstrate the outcomes others.

5.4.11 Fear of increased scrutiny

A general fear associated with EMS use is that of finding things the managers do not want to know – effectively the revelation of ‘environmental skeletons in the closet’. Cassells et al. (2008) further suggested that the scope of legislative requirements that needed to be addressed was not made explicitly clear under ISO 14001. The fear of the unknown can therefore create anxiety that an EMS will identify a suite of environmental matters where performance is less than perfect. This can be a significant area of concern, and business operators may feel such matters are better left unknown or at least unspecified (CEC 2005). In particular, the fear of discovering non-compliances can create concern that the business has been opened to risk of regulatory attention and prosecution.

Concerns that EMSs would generate data that could be used against a business in the event of an environment incident have also been raised. This could happen through the creation of “discoverable documents” that could form part of potential legal cases (Minoli and Bell 2002, p.362). Thus, data produced by an EMS could form “damaging, as opposed to vindicating evidence” (Minoli and Bell 2002, p.362). Yirridoe (2000) highlighted similar concerns amongst farmers considering adoption of the Ontario Environmental Farm Plan, as did Tinning and Carruthers (2002) when working with grain farmers who participated in the NSW Agriculture EMS Pilot Project. Seymour et al. (2007) also reported fears amongst farmers of ‘regulatory

creep' arising from EMS use. Farmers in that study were concerned that once they had addressed current issues, ever-increasing levels of compliance would be expected. Somewhat ironically however, Geno (1999) claimed that while farmers were generally 'violently opposed' to regulation, 80 percent rated themselves as either 'very concerned' or 'concerned' about the environment, and believed that regulations was required to ensure that farmers used resources appropriately.

Finally, concerns have been expressed by farmers that regulators were not aware of the problems of implementation of legislation (Geno 1999). In some cases, farmers were fearful that the cost of meeting environmental regulations would outweigh the possible profits made from farming.

5.4.12 Need for increased performance

The fear of regulatory creep ties in with a misunderstanding of the commitment required to continual improvement detailed in the AS/NZS ISO 14001 Standard. In the Standard (Standards Australia 2004: p.1), continual improvement is defined as a:

recurring process of enhancing the environmental management system in order to achieve improvements in overall environmental performance consistent with the organization's environmental policy.

In addition, the 'Act' portion of the PDCA cycle is defined as "take actions to continually improve performance of the environmental management system" (Standards Australia 2004a, p. v). This is often interpreted to mean that regulations imposing increasingly stringent performance outcomes can be brought to bear. However, in actuality, the iterative nature of the ISO 14001 means that the system itself is continually improved and therefore, by default, also the performance. Continual improvement may lead to the setting of higher targets as a consequence of reviewing the system, but does not mean that there is no end-point for performance. Nash and Ehrenfeld (2001) pointed out that while this requirement may mean that the participation rate in EMS is reduced, actual performance rates are enhanced amongst participants. In addition, other business improvements are often introduced as a result of the commitment to continual improvement, such as improved training, enhanced communication and better target setting. Such issues allow increase performance across the full gamut of business operations, not solely environmental performance.

5.4.13 Policy

Schulman et al. (2000) highlighted that many of the agricultural subsidies provided in the USA actually counteracted incentives for EMS adoption. Such subsidies reduce the real costs of water and chemical inputs for agricultural enterprises, meaning that the pollution prevention and environmental management initiatives expected under an EMS regime seem to be far more costly than the environmental management of such issues. In other words, it is cheaper for a farmer to continue to act in an environmentally damaging manner than it is to address such issues. This situation is likely to continue for as long as subsidies are divorced from their environmental consequences. Gunningham and Young (1997) and Gunningham (2007) called for such perverse economic incentives to be removed prior to the introduction of positive incentives, in order to prevent distortion of the effectiveness of new instruments. The issue was addressed in the European Union where reforms within the EU's Common Agricultural Policy (phased in from 2004 to 2012) transferred subsidies to land stewardship rather than specific crop production payments (Tony Pexon, former President of British National Farmers Union; *pers. comm.* 2003). Calls to further strengthen such arrangements were made in March 2010, expanding the range of environmental issues to be considered when providing subsidies (EurActiv 2010). Bridgen (1996) believed that the Australian government was not as supportive of ISO 14000 as various industry sectors were, possibly due to concerns regarding performance outcomes. Consequently, agencies in general have not actively encouraged or adequately supported the use of EMS in the past, and farmers have often been resistant to using the process. Linking payments to demonstrable environmental performance outcomes provided greater incentives for farmer involvement in active environmental management. While Australia provides farmer support in terms of extension, agency advice and research, little use has been made thus far of subsidies or direct incentive payments to adopt changed practices, with environmental stewardship rarely directly linked to financial arrangements. The growing use made of environmental services payments may alter this situation.

5.4.14 Credibility

There has been a fear that the use of EMS provides an opportunity for 'greenwash' – that is the promotion of productions, actions and services on the basis of their environmental friendliness, without suitable and comprehensive action to actually

make environmental practice change. Netherwood (1996, p.54) encapsulated this fear in the following statement “It could also be argued that organizations will use the EMS standards as a marketing device, and as a smokescreen to pacify concerns regarding environmental performance, instead of a catalyst for cultural change in order to provide real and significant improvements in environmental performance”. Cary et al. (2004) detailed how greenwash can undermine consumer confidence in green claims and eco-labels. To some extent, this has had a spill-over effect on EMS, as retailers and consumers are uncertain of what EMS actually means (if they have heard of it at all) and so are inclined to keep EMS in the greenwash category, in the absence of better information. Seymour et al. (2007) also highlighted this issue.

6.0 Conclusion: establishing the value of the research

At the time this research commenced, little consideration had been given to the similarities and differences that could arise from the application of EMS to agricultural, when compared to more traditional business applications. Indeed the application of EMS to agriculture was barely considered in the literature. The research discussed throughout this thesis provides evidence of the utility of this systematic process of management in agriculture, just as has been found in other industry sectors. It highlights that there are many similarities between industries, while also showing applicability in a non-traditional field (agriculture). Further, this thesis serves to highlight the critical role that social factors play in EMS adoption, features that are critical for embedding behavioural changes amongst farmers.

While many parallels were noted between farmers and other SMEs adopting EMS, some differences in drivers and motivations, or the magnitude of the effects of these issues occurred. For example, corporate image may not be as important as driver for farmers in terms of individual businesses, but industry image overall may be. This can be especially the case for growers of basic commodities, who have fewer chances to differentiate their products individually. Therefore, differences between intensive and broadacre users, for example, in EMS drivers might be expected. Similarly, while compliance may be a driver for farmers, the context may be different. While the regulations governing agriculture are less specific, farmers often exhibit a general fear of legislation; whereas bigger businesses have more specific legislation and regulations to deal with, and penalties are often spelt out in greater detail. Again, some differences might therefore be expected between point-source operations (such as intensive livestock), and those producing more diffuse pollution sources (such as extensive grains and livestock operations).

Diverse benefits have been reported by a range of industry sectors – both to the individual business as well as to public good outcomes. Positive EMS outcomes have been noted in the profit, people, and policy areas. This study shows that use of EMS provides a similar diversity of benefits in the agricultural context. These occurred at the personal, business, policy, and process levels. Some of these were tangible and measureable using recognised contemporary indicators, however, others were more intangible, and in some cases often not recognised or regarded, due to limited

assessment or differing scopes, contexts and appreciations, and lack of benchmark data against which to assess performance. Further, EMS use answers many of the policy and management questions that we have regarding the improvement of NRM in the agricultural sector.

Further value from this research occurs through identification that EMS adoption in agriculture faces many of the barriers facing EMS adoption in other SMEs. Identification of these commonalities means that it is likely that some of the solutions suggested for other industries to assist with EMS adoption will also apply to agriculture. However, it is worth bearing in mind the observation from Anthony (1996, p.110) who noted that:

One major difference between agriculture and other industries is that individual farms, although producing a range of similar products, are not in direct competition with each other for a limited number of purchasers. There is therefore no need to maintain secrecy about working practices, but rather it is customary to share experiences and knowledge. This factor is significant in adopting a group approach to applying an EMS.

This thesis demonstrates that the EMS process does not need to change greatly to be applicable on farm. However, a number of factors inhibiting adoption in agriculture were obvious. The support required for EMS development and implementation is likely to change over time. This occurs in part because specific elements of the EMS process requiring more attention alter as the process is implemented. Indeed, the overall business structure will also evolve as the EMS becomes more embedded. Therefore, EMS support and incentives should also change accordingly. In Australian agriculture, support for EMS development and implementation was provided for the initial awareness raising and EMS development only, with very limited long-term support available. Indeed, Bridgen (1996) indicated that Australian governments were sceptical about potential gains possible from EMS, and therefore provided limited support for EMS adoption for a number of industry groups.

Often many of the benefits of EMS are intangible, or take a long time to become apparent. Additionally, many of the benefits are actually valued more by the community than the individual (for example, biodiversity conservation). Therefore, government has a role to encourage adoption and innovation, particularly where the environmental objectives and outcomes do not provide a direct financial benefit to those providing the services/stewardship.

Along with inducement to use and support to implement EMS, agricultural industries also have a significant role in creating awareness of the benefits of EMS use not only to the individual, but also as a way to enhance industry image.

Publication 1: Adoption of Environmental Management Systems in Agriculture

Carruthers G (2003) 'Adoption of Environmental Management Systems in Agriculture Part 1: Case studies from Australian and New Zealand farms' Publication No. 03/121 (Rural Industries Research and Development Corporation: Canberra). Reproduced with permission from RIRDC, Barton, Canberra.

The case studies are presented as the first publication in the thesis as they were the genesis of my PhD research and prompted the major research questions. The stories of farmers contained within this publication were pivotal in determining the direction of my EMS research for the next several years. The case studies highlighted to me the influence of the individual farmers' behaviour and personality on adoption, and emphasised the importance of the social factors in changing management approaches and behaviour. This realisation meant that I had to look more widely than my ecological science background and training, and to explore the social issues of adoption further.

It seemed apparent that farmers who adopted an EMS were somehow different from their peers, but the case study approach was not designed to effectively discriminate these features. While this publication did not allow me to pin down the differences between adopters and non-adopter, it was clear that there were different patterns of thinking and expectations of management tools between the two groups, and I wanted to further assess what these differences might be.

As far as I am able to determine, this was the first study of EMS adoption using ISO 14001 amongst farmers conducted world-wide. The study represents an important contribution to the literature available on early EMS adopters, and provides an insight into development and implementation of EMS in field that at the time was not the norm.

The research in these case studies was a direct outcome of the first EMS in Agriculture workshop in 1999. Delegates at the workshop included the key

stakeholders in agriculture, and they concluded that more needed to be known about the drivers, methods, costs, benefits and outcomes of EMS adoption amongst farmers. In 2000, I gained funding from the Rural Industries Research and Development Corporation to investigate these and other questions.



Australian Government

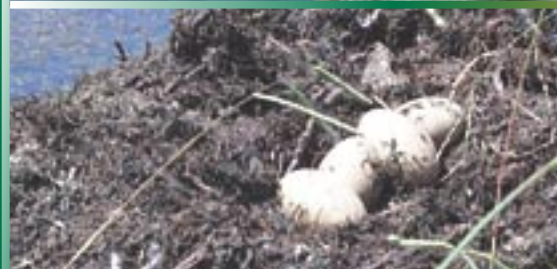
Rural Industries Research and
Development Corporation

Adoption of Environmental Management Systems in Agriculture

Part 1: Case Studies from Australian and New Zealand Farms

A report for the Rural Industries Research and
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by Genevieve Carruthers,
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Foreword

The Rural Industries Research and Development Corporation (RIRDC) has prioritised research on Environmental Management Systems (EMS). In 1999 the Corporation provided most of the funding for a national workshop on EMS in Agriculture held at Ballina, NSW. RIRDC was also a major sponsor of the National EMS in Australian Agriculture Conference, held in November 2001.

At the workshop, delegates said they wanted to know how a farmer might develop and implement an EMS, and to learn how such implementation might provide benefits for the farm business. They wanted to know what the environmental outcomes might be, and whether using the EMS process would actually help address the many environmental issues facing Australian agriculture. Consequently, RIRDC funded these case studies to begin to answer these and other questions.

This publication records interviews conducted with 40 farmers and farm managers in Australia and New Zealand. Some had adopted a recognised EMS process using the specifications of the internationally recognised Standard for EMS, ISO 14001. Others used less formal approaches. Benefits and costs were diverse, as were motivations for adopting environmental management approaches. All had made progress in addressing the environmental issues faced in managing their farms. A second publication by the author will provide an analysis of these case studies.

As EMS adoption is in the early stages worldwide in agricultural industries, this study provides an important benchmark for future EMS implementation on farm. It also provides a number of important pointers for support of farmers who wish to utilise EMS as a management tool in the future.

This project was funded from RIRDC Core Funds provided by the Federal Government and is an addition to RIRDC's diverse range of over 1000 research publications. It forms part of the Resilient Agricultural Systems R&D program, which aims to foster the development of agri-industry systems that have sufficient diversity, integration, flexibility and robustness to be resilient enough to respond opportunistically to continued change.

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- downloads at www.rirc.gov.au/reports
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Simon Hearn

Managing Director

Rural Industries Research and Development Corporation





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Many people have made this publication possible. Firstly, I would like to thank the farmers and farm managers who devoted so much time to the interview process and the subsequent checking of stories and data produced. Their efforts in contributing to improved environmental outcomes in the Australian agricultural landscape are to be applauded, and their generosity, experience and assistance is very gratefully acknowledged. The participating farmers and farm managers were:

Cecil Camilleri (Yalumba Wines)
Chris and Christine Gillam (Gillam Farms)
David Ingerson (Ingerson Citrus)
David McLeod (Boen Boe)
Frank and Dianne Sciacca (Pacific Coast Bananas)
Geoff Kingston (NAPCo.)
Jim McDonald (Red Braes)
Julie and Neil Hamilton (Shalloch)
Kevin Niemeyer (Lyndarra Farms)
Kim and Dianne Diamond (Guyescliffe)
Mark Taylor (Bartter Enterprises)
Michael Blake (Bally Glunin Park)
Mick McGinnis (Rivendell)
Mike Logan and Rachel Holloway (Oakville Pastoral Company)
Mike Muller (Mike Muller and Associates)
Nick Gill and Peter Ashby (Southcorp Wines)
Owen and Judith Ruddenklau (Garamea)
Pam and Jim McGregor (Maybenup)
Pat and Anne Francis (Moffits Farm)
Paul and Tina Badcock (The Hermitage)
Paul Ziebarth (The Gums)
Peter and Janelle Witten (Witten Holdings)
Peter Jones (Andamooka)
Peter Paradice and Paul Troja (Rockdale Feedlot)
Ray Whear (Abbotsleigh Citrus)
Rob Wilson (Wandalup Farm)
Rohan Koenig (Rocky Point Prawn Farm)
Ron and Suzanne Watkins (Payneham Vale)
Ross Garsden and Dennis Williams (Main Camp)
Ross Seagar (SoFresh).
Russell Ford (Old Coree)
Ruth and Phillip Paterson (Moreton Hill)
Steven Mackay (Bolinda Estates)
Stuart and Leanne McAlpine (Cooinda)
Syd Clarke (Samara)
Tony Hoksbergen and Mike Insley (Montana Wines)
Trenton Hadie (Stehr Group)
Virginia Brunton and Chris Miller (Eastwood Nurseries)
Wesley and Pauline Giblett (Roadside)
Wesley Hazell (Forest Home)

The Rural Industries Development Corporation funded this project, and contributed major sponsorship to the 1999 EMS in Agriculture Workshop, from which this project grew. It was also a major sponsor of the 2001 EMS in Australian Agriculture Conference. The assistance and support of the Corporation, particularly that of the Resilient Agricultural Systems Program Manager, George Wilson, is acknowledged. By supporting EMS research in its early days, George was one of the first R&D program managers to recognise the emerging importance of EMS to both consumers and producers. His extreme patience during the lengthy preparation of this report is especially appreciated.

NSW Agriculture staff (Gioia Small, Suzanne Robinson, Chris Cole, Belinda Walker, and Genevieve Carruthers) conducted the interviews. These people and Gavin Tinning (NSW Agriculture) wrote the stories in collaboration with the farmers. Gioia Small produced the maps for all stories. Genevieve Carruthers edited and finalised all stories and wrote the associated chapters.

Wendy Dingle, Lyn Cullen, Narelle Tomlinson, Jim Hindmarsh (all NSW Agriculture staff), and Brigita Arrowsmith (Southern Cross University) assisted in typing interviews, entering data and producing figures. Lyn Cullen, Wendy Dingle, Jillian Cooke, Nina Cannell, and Gavin Tinning assisted with proof reading the stories. Christine Vines, Wendy Dingle, Jenny Grant (all NSW Agriculture) and Carol Reeve, Merryn West and Cecile Ferguson (all of RIRDC) did a fantastic job with the formatting and compilation of the final document. Their patience and tolerance are very gratefully acknowledged. Kay Hindmarsh provided valuable editorial and proof reading services in addition to giving a producers' perspective on the document.

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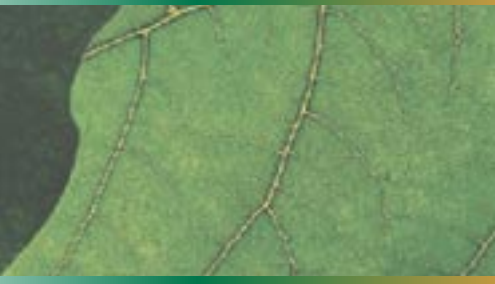
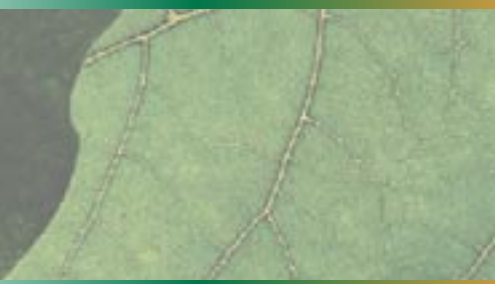
Finally, thanks to Phillip, Aaron and Georgia for putting up with all the lost evenings and weekends.

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September 2003





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Introduction

The application of environmental management systems (EMS) on farms is in its infancy worldwide, despite the wider application of the process in other industry sectors. For many people, both in Australia and overseas, the concept of applying a management process to natural resource management on-farm is foreign; uncertainty and scepticism of improved environmental outcomes are common. Application of EMS processes typically within the secondary industry sector has led to a perception by some in agricultural industries that use of EMS on farms is “beyond farmers”, “too hard”, “too complex” or “too expensive”. Interestingly, many of the same perceptions were also been expressed about the application of EMS in the industrial sector in earlier times (see Corbett and Kirsch, 2000, Andrews *et al.*, 2001).

Much of the uncertainty regarding benefits and costs of EMS implementation on-farm comes from a lack of information regarding the use of EMS in agriculture – an issue this research aimed to address.

Information on the use of EMS in the past has largely come from the secondary industry sector, or from large companies (Johannson, 2002). The associated performance measures and analysis of outcomes have therefore concentrated on issues and metrics that are pertinent to those industries and they often have limited relevance to agriculture. Many of the methods of evaluation and measurement that might be used to evaluate effects of EMS within a business may not be appropriate for agriculture, but this does not mean that farm businesses cannot benefit from the application of a management process. Hilary (1999) reported that EMS implementation in small to medium enterprises (SMEs) yielded real and valuable benefits. Farms, which may rightly be regarded in many instances as ‘nano-enterprises’, should also realise benefits from EMS implementation, but these benefits may differ from those observed in secondary industry application.

In Australia, a national workshop examining the use of EMS in agriculture (funded by NSW Agriculture, the Rural Industries Research and Development Corporation, Land and Water Australia, and others) was held in 1999 at Ballina, NSW. This was the first time that Australian agricultural stakeholders had gathered to discuss the implications of EMS implementation on Australian farms (Carruthers and Tinning, 1999). The use of EMS in Australian agriculture has since gained international attention, with Australia recognised by many as a world leader in the application of the EMS process to farms.

At the Ballina meeting, a range of questions regarding the value of using this process on-farm was raised. The questions included the motivations for EMS adoption, benefits, and costs arising from implementation of an EMS, and methods and information available to support farmers wishing to use an EMS approach.





The case studies detailed in this publication were developed to meet the expressed desire of the 1999 workshop delegates for information about the application of EMS to farming enterprises. Does the use of EMS help farmers manage better? Are there any differences between using an EMS and addressing environmental issues in other ways? Are there market advantages to be gained? How do farm managers go about developing and implementing their EMSs and where do they get help? What does implementing an EMS cost? What are the environmental outcomes that arise? What benefits accrue to the business?

One central question addressed by this study was “Does using an EMS add anything to existing farm management, where the farmer is already operating at a recognised ‘higher’ level of environmental stewardship than their peers”?

A second publication *Adoption of Environmental Management Systems in Agriculture Part 2: Analysis* by Genevieve Carruthers, RIRDC Publication Number 03/122 will provide an overall analysis of these case studies.

What is an EMS?

A business, or other organisation, implements an EMS in order to improve the way it manages the environmental impacts under its control. In many regards, an EMS is a vehicle for moving information around inside a business or entity, so that better decisions can be made (Sheldon and Yoxon, 1999). An environmental management system (EMS) is a process designed to:

- assist with the recognition of environmental impacts, compliance issues, risks and liabilities
- develop an environmental policy that clearly states the aspirations, methods and timeframes to address these impacts
- gather and refine the information and data needed to meet the policy aspirations
- review and evaluate management choices in the light of whether the outcomes achieved met those specified within the environmental policy

The EMS process has been codified in two cases into internationally recognised documents, the ISO 14000 series (of which the ISO 14001 Standard provides the specifications for developing an EMS, and against which certification can occur) and the Eco-Management and Audit Scheme (EMAS), an European Union regulation. Only ISO 14001 can be used in Australia for certification purposes, as the use of EMAS is limited to EU countries on a site-specific basis. The Australian and New Zealand Standard for EMS, AS/NZS 14001: 1996, is identical to that recognised internationally and known as ISO 14001, and defines an EMS as:

“The part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures and resources for developing implementing, achieving, reviewing and maintaining the environmental policy” (Standards Australia, 1996).

This Standard forms part of a larger series of documents, known as the ISO 14000 series, which provide guidance and tools for addressing environmental impacts and issues. ISO 14001 is a voluntary Standard. It is recognised and accepted in over 170 countries of the world. Panayotou (2001) points out that many countries which market products internationally find it easier to gain recognition for their environmental management efforts when they use internationally recognised standards for certification, rather than domestic standards. This is particularly the case where the domestic environmental performance standards are perceived to be 'weak' compared to international competitors standards. Use of such an internationally recognised process may well be crucial in order to gain credibility for 'clean, green' claims for goods entering an international marketplace, such as Australian agricultural commodities.

An EMS is an on-going cycle of planning, implementing, reviewing and improving the processes and actions that a business or organisation undertakes to meet both its own desired, and where applicable, externally legislated or regulated, environmental obligations and aspirations. An EMS features a process of continuous improvement, and is based on management principles that are common across a range of management areas such as quality, occupational health and safety, and financial factors. The EMS management cycle and constituent elements are depicted in the figure below.

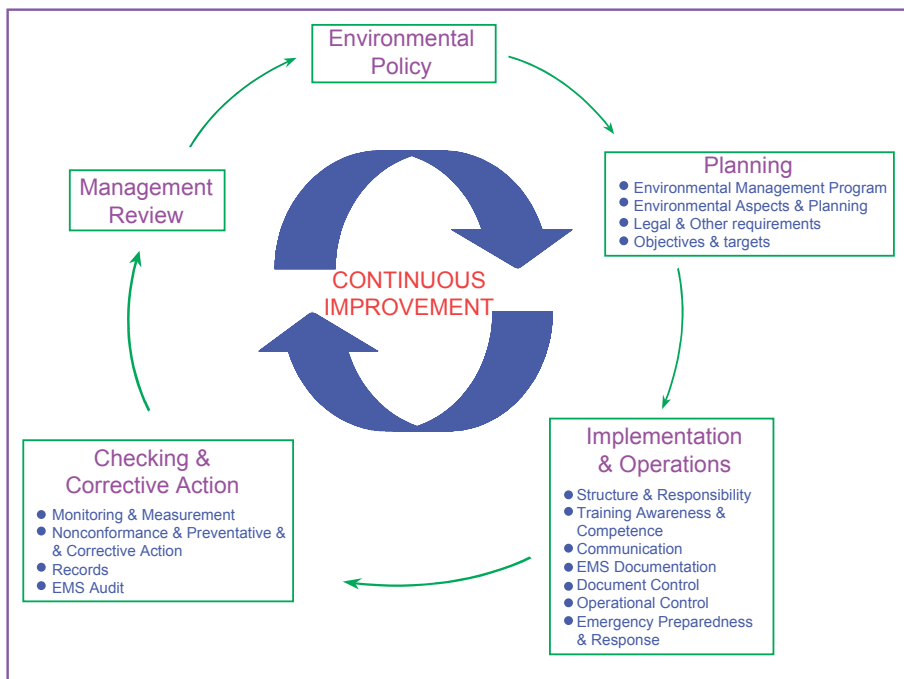


Figure 1. The EMS cycle



Certifications against the ISO 14001 Standard worldwide numbered over 22,000 in 2000 (ISO, 2000). By August 2000, 205 of the certifications recorded worldwide were in agricultural or fishing businesses (ISO, 2000), growing from 16 in 1998. Australia in 2000 had 341 new certificates issued (for a total of 1049), ranking it sixth in the world behind Japan, UK, Sweden, USA and the Netherlands. In 2002, there were over 30,300 organisations throughout the world with a certified EMS (Morrow and Rondinelli, 2002; Babakri *et al.*, 2003). It is important to note however that not all businesses achieving certification to ISO 14001 make this information available to the ISO, and so these numbers are likely to be under-estimates. In addition, businesses using the ISO 14001 process may also choose not to undertake third-party auditing and certification, while still operating a successful EMS. Such implementation rates are more rapid than those noted for the adoption of the international Standards for quality assurance (the ISO 9000 series), another series of internationally recognised management standards comparable to the ISO 14001 approach. Corbett and Russo (2001) observed that while ISO 9000 series generated 28,000 registrations in the first six years of use, the ISO 14000 series had 23,000 registration within the first four years. Corbett and Russo (2001) therefore suggested that ISO 14000 adoption globally will proceed at a greater pace than the ISO 9000 series. This may be because the ISO 9000 'paved the way' and introduced businesses globally to a process approach to management that has been included (and some say, enhanced) in the ISO 14000 series.

Study Methods

Choosing case study participants

Potential case study participants were identified by recommendations from farmer and industry groups, state agricultural or resource conservation agency staff, certification companies and from publicity about farmers who had won environmental awards. Other areas of interest in selecting potential candidates were farm businesses making use of environmental labelling or marketing, and those who were selling into known 'environmentally sensitive' markets.

Criteria for inclusion in the study included the ability of the participants to demonstrate commitment to improving environmental outcomes associated with their farming activities, recognition of the environmental outcomes being achieved on the farm, and willingness to take part in the project. Some participants in the study were using the ISO 14001 Standard to guide their management, but many had never heard of the Standard. All participants had gone beyond the development of a farm plan and were actively engaged in addressing environmental issues on their farms and in their businesses.

Over 70 potential candidates were identified by this peer recommendation process and these candidates were initially interviewed by telephone to assess:

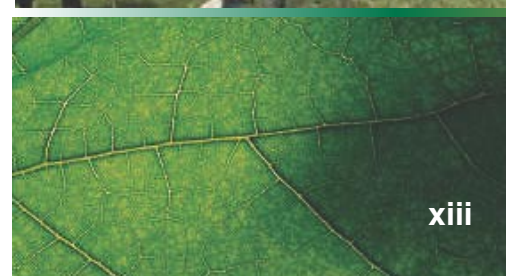
- their willingness to participate
- whether or not they were using some form of farm plan
- the issues addressed in that plan
- environmental issues facing the farm
- potential and actual impacts of farming operations on the environment
- how these impacts had been recognised
- whether there was a formal environmental policy statement (either written or verbal)
- what monitoring was being undertaken to assess progress towards the stated goals
- how such monitoring was being used in decision making
- whether the interviewee or farm staff members was involved in any farming, industry or research groups

From candidates selected for the initial interview, 40 were chosen for the full interview process. Of these, 35 farms were in Australia and 5 in New Zealand. Of the participants, 17 were using a formal EMS approach based on ISO 14001 or related systems (hereafter referred to as “EMS farms”). The other participants were addressing environmental matters in other ways, using various environmental management programs (hereafter referred to as “EMP farms”) that did not include all elements regarded as ‘systems’ elements in their overall management approach.

Final participants were selected on a number of criteria, including:

- their ability to clearly articulate, or provide a written version of, an environmental policy for their business
- the degree to which they were applying a ‘systems process’ to their farm management
- the application of an assessment ‘process’ to identify environmental issues of concern (both on-farm and in the local area)
- the use of monitoring to assess progress towards goals
- the use of some form of review process to evaluate progress
- their willingness to participate in the trial
- their availability for interview
- the level of development of their environmental management system or program
- the range of enterprises pursued

Selection of the final list of participants also considered State and industry sector to include as wide a range of locations and industry types as possible. A wide range of size of operation was considered, from single operators through to large company farms.





Interviewing farmers and farm managers

Following the final selection of participants, a full interview process was undertaken. The interviewers visited the farms, and talked with as many as possible of the staff involved in the environmental management on-site. Supporting material such as environmental policies, monitoring and recording data, and any eco-labelling or marketing/promotional materials were also reviewed. The interviews were transcribed and approved by the farmers, and full stories subsequently developed. The participants approved the final stories featured in this document. In some cases, participants requested non-disclosure of some information in stories. These requests have been adhered to in the stories that follow.

The interviews aimed to determine the motivations that led the managers to adopt more formalised approaches to environmental management. Questions addressed the following issues:

- farm history, description and location
- sources of income and mix of enterprises
- training and experience of the managers and staff (if any)
- environmental issues covered in the farm plan
- motivations for change
- management changes applied and the methods used to do so
- sources of information used
- indicators and monitoring used to assess change
- communication
- benefits and costs of changes to management
- marketing (if any) of changes made
- perceptions regarding the role of government, industry and the community
- confidence in management
- perceptions on the future direction of management.

This document provides all of the farmers' individual stories in the form of case studies. Data from the interviews has been compiled. A forthcoming RIRDC publication *Adoption of Environmental Management Systems in Agriculture Part 2: Analysis*, RIRDC Publication No. 03/122, will present the analysis of all interview questions, and will provide some answers to questions posed in 1999 at the EMS workshop. It will also highlight area of further research required and suggest partial solutions to some of the issue raised by case study participants in this study.

The full questionnaire used in the study has been provided as Appendix 1 to this report. Appendix 2 provides a glossary of terms used in this publication and appendix 3 provides references cited.

Abbotsleigh Citrus

Riparian fruit farm in a rainforest

Ray Whear

Originally conceived in the later part of 1995 by the Managing Director, Ray Whear, Abbotsleigh Citrus is a privately owned company which has become one of the leading innovators within the Australian Citrus industry.

From the beginning the directors of Abbotsleigh Citrus have maintained two basic philosophies. The first is to fully embrace the concept of sustainable agriculture, which includes the protection and enhancement of the environment. The second is to strive for excellence in all facets of the operation. They have chosen to use both environmental and quality management processes to help them achieve these objectives.



Abbotsleigh Citrus (2000) is located in a "U" bend of the Burnett River.

was recently described as one of Australia's most endangered parrot species. The farm is also part of the sensitive Burnett River system.

The Staff

There are 22 permanent staff members at Abbotsleigh, with two employed to do only environmental work. Most of the farm staff have secondary education.

Ray Whear has worked as a farmer for most of his life and has completed tertiary studies. He spent 20 years in the mango industry before moving into citrus.

Three other staff members hold tertiary qualifications: two have Bachelor of Science degrees with Honours in Horticulture, a third has a Geography degree. The latter staff member is also a Food Safety Systems facilitator and has quality management training. The business is a member of the Queensland Fruit and Vegetable Growers Association, the Produce Marketing Association and Australian United Foods.

The Farm

Abbotsleigh Citrus is a 512 ha property situated at Wallaville, 56 km west of Bundaberg. In the past it was a dairy farm which was later converted to beef cattle and sugar cane. In 1996 Abbotsleigh Citrus purchased it.

The farm is located in the habitats of the Coxen's double-eyed fig parrot and lungfish. The Coxen's double-eyed fig parrot

Authors:
Belinda Walker and
Genevieve Carruthers



Location of Abbotsleigh Citrus



Case studies – Queensland

- Abbotsleigh Citrus
- Wainui Feedlot
- Pacific Coast Bananas
- Bolinda Estates
- Rocky Point Prawn Farm
- Rivendell
- Lyndarra Farms
- The Gums

The Environmental Management System (EMS)

The property was very run down when it was purchased, with several badly eroded sections along the riverbank and complete lack of regeneration of young trees, due to cattle having free access to the riparian zone. Control of weeds and biodiversity management have featured highly in the development of the EMS.

Ray's philosophy is to try to get everything right from the beginning. The farm has ISO 14001 and ISO 9002 certification. Abbotsleigh also was the first farm in Australia to be certified by Australian Biological Control "Bugs for Bugs."

The main environmental issues for the farm are related to water quality and the control of pesticide and fertiliser runoff. Specific areas covered include citrus cultural practices, water management, chemicals storage and handling, air management (with special regard to buffer zones, careful calibration and application), integrated pest management and biodiversity management. The packing sheds are also included under the EMS. Ozone technology is used for sterilising the fruit, so chemicals, chlorine and oxidisers aren't used in the packing process. Fruit washes and dips are not allowed to drain into creeks or other waterways, but are all contained.

Production and environmental issues are fully integrated, with management being enhanced through the use of a systems approach. Ray says *"Almost every aspect is interconnected with other issues, so it is difficult to split issues up"*. However, fertiliser management and prevention of runoff are particularly critical since the river bounding Abbotsleigh is a lungfish breeding area.

In the past four years, since Abbotsleigh Citrus commenced operations, there has been a major transformation, not only of the farming enterprise, but also of the farm environment in general. All the internal fencing has been removed and about 48,000 citrus trees have been planted, mainly lemons and mandarins.

But citrus are not the only trees Abbotsleigh have planted. Part of the company's philosophy is to re-establish a balance between the native vegetation and the commercial plantings. Numerous rainforest species have been replanted in an ongoing program to repair the riparian zone of the river and rid it of the noxious cat's claw, an invasive vine that smothers all the other vegetation.

Landcare acts as a consultant to Abbotsleigh, advising on which species of trees should be reintroduced. The order for December 2000 was for some 2000 native trees. In addition to this, Abbotsleigh collect and propagate seed from the remnant vegetation still present on the property.

The local Landcare representatives have told Ray Whear that his regeneration project of 3-400 ha is probably the largest in Queensland to be taken on by a single landholder.

Case studies – Queensland

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Initially, when Ray began to develop the environmental management program on Abbotsleigh, he was not aware of the ISO 14001 Standard. Therefore a lot of the earlier development on Abbotsleigh was not recorded or documented.

Several management approaches are incorporated through the ISO 14001 program. By integrating these approaches the common complaint about multiple schemes and their associated audits are avoided. Ray believes that the answer to this is to “start at the top, in the ISO standard. Their standards exceed SQE, they exceed HACCP, so if you comply with ISO, you don’t need to be audited by the others.”

The management of native fauna is another area of management in the EMS. For example, a long period of dry weather and poor planning by the Department of Natural Resources recently resulted in water levels dropping significantly in the river, stranding a number of lungfish in isolated pools of water.

The stagnant water in these pools rose to quite extreme temperatures, necessitating the transfer of dozens of lungfish back to the main stream of the river.

Ray Whear and Maureen Schmitt (pictured below with lungfish), the Bundaberg Landcare Coordinator and conservationist, successfully completed one of these operations in October 2000. Ray carried out many earlier and undocumented transfers alone.

The biodiversity changes are acting in the interest of Abbotsleigh. The increasing numbers of predatory insects assist with the integrated pest management program and contribute to the reduction in pesticide use.



Lungfish Rescue



Black Bean seedlings propagated from remnant forest on Abbotsleigh

Monitoring

Monitoring results are incorporated into a six-monthly review. Records are mostly kept on computer (or as photographs) and managed with a database. Farm staff record information in notebooks and data is then transferred to the computer. There is also an optical fibre system that allows visual review of most areas of the farm.

Case studies – Queensland

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Benefits and Costs

Ray estimates that about \$2 million has been spent so far on environmental projects. This covers training, infrastructure, consultancy fees and systems development. For example, a backhoe operator has been employed full time (on contract for \$45 per hour) for the last four years and worn out two backhoes, just doing Landcare work. Much of this work aimed to remove the weed cat's claw, to prevent it entering rivers and spreading along the banks.

ITEM	HOW OFTEN
Soil heavy metals and trace elements	Annual soil tests
Revegetation areas and biodiversity	Photographic surveys are done every 3 months
Bird counts	Surveys are done every 3 months
Erosion areas	Assessed every 6 months, photographed for comparison
Water quality in dam	Mussels kept in dam are monitored for health every 6 months
Chemical loss from packing shed	Water leaving shed is tested for residues annually
Chemical/fertiliser runoff	Water tested before it enters the river, at times of high rainfall
Waste reduction (chemicals, containers, sump oil etc.)	Inventory used, continuously assessed to find ways to reduce and recycle

Schedule of monitoring activities

Laser levelling was a major area of investment and served two purposes. The first was to spread drainage waters, reducing erosion; the second meant that a greater area of the farm remained productive and accessible, even after rain. Ray points out that much of the work done on the farm would have occurred whether an EMS was implemented or not and involved production and crop issues.



Rainforest trees replanted in the riparian zone after the removal of cat's claw vines

Case studies – Queensland

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To put this in perspective, Ray expects the farm to generate \$12-14 million per annum when it reaches full production.

When questioned about the shareholders' acceptance of expenditure on environmental management, particularly before the orchard was operating at a profit, Ray's main response addresses savings in the area of integrated pest management (IPM). *"It's really simple – you need to get away from the monoculture environment. Where you only have citrus, you only have citrus pests"*.

"The aim is to create a balance on this property, with more native trees than citrus." As evidence that his strategy is already working, Ray points to his chemical costs. *"Last year with 48,000 trees in (three times more than the first year), our chemical costs were \$40,000 less than they were in our first year."* Although they tried

to use IPM from the beginning, protection was inadequate until a bigger, more mixed population of insects, including predators, became established.

The Future

Ray is completely committed to addressing environmental issues as a core component of the company business. He is totally confident that this approach will be justified and can already see evidence that Abbotsleigh is being recognised for its approach. Through its environmental certification Abbotsleigh has been recognised under the Japanese environmental standard JIS Q 14001: 1996, paving the way to acceptance into this highly competitive market.

Further evidence of recognition was Abbotsleigh's selection as a finalist in two categories ('Small Business Responsibility and Leadership' which they won and 'Bush Land and Waterways') at the recent Banksia Foundation Environmental Awards (Australia's premiere environmental award) held in Canberra.

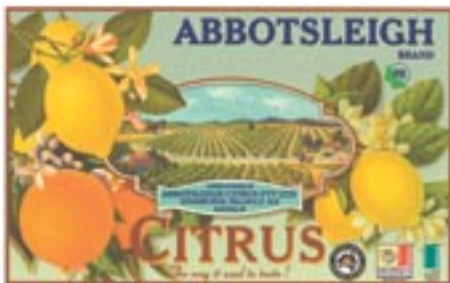
Since receiving the Banksia Award, Abbotsleigh has been approached by Australian Ethical Investments Ltd with a view to future investment in the company. Abbotsleigh will continue negotiations with Australian Ethical Investments subject to due diligence.

Ray says that in Europe, the demand for "the environmental aspects of the product" are extremely strong. "I can see that ISO 14001 has become virtually a prerequisite to get fruit into Europe", says Ray. On the other hand, he feels that in Australia, although the consumers care about the environment, the agents and wholesalers are mainly concerned with perceived quality, at this stage. They are looking for an absolutely spotless piece of fruit and the trouble is that relying on IPM can mean that fruit has minor external blemishes. But ten years ago, organic fruit was being rejected for the same reasons and consumer pressure has forced a change.

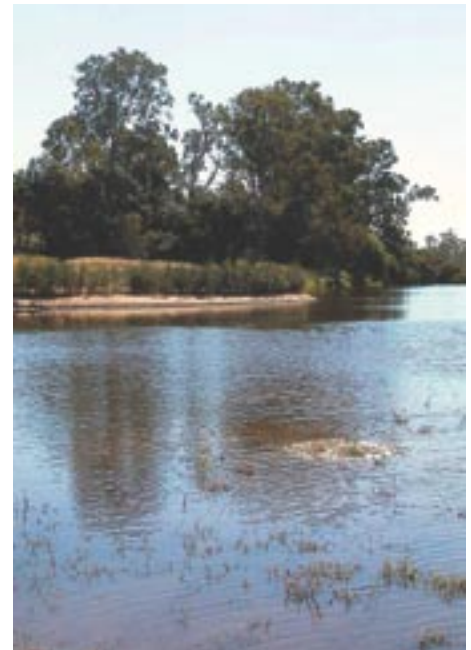
The 'Abbotsleigh Citrus' label incorporates their environmental, QA and IPM certification. It is about to be redesigned to include ACF, Landcare and Birds Australia endorsement. A percentage of the profits from each box of fruit sold will be donated back to these organisations.

When Ray sums up the benefits of his endeavours, he simply says "It's a great place to work. We're heading towards having the best farm in Australia." He is confident that

Abbotsleigh is a sustainable business that produces high quality fruit and enhances environmental values in the area. He believes that their work is also providing a positive image for the industry as a whole.



The Abbotsleigh label incorporates their certification status to ISO 14001 and 9002.



Banks that used to collapse and wash away with each flood have now been stabilised. This has resulted in a relatively lush riparian zone compared to much of the Burnett.

Case studies – Queensland

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Authors:
Belinda Walker and Genevieve
Carruthers

Wainui Feedlot (NAPCo.)

Flexible management options improve environmental care

Geoff Kingston

The North Australian Pastoral Company (NAPCo.) owns 12 properties in Queensland and the Northern Territory (see map on page 28), the first of which was purchased by family members in 1877.

One hundred percent of the company's income has always been from cattle, but in the past the business was essentially a "cattle harvesting operation," where mainly 4-year old bullocks were rounded up and sold straight off pasture.

However, that changed in 1985, with the purchase of Wainui feedlot at Bowenville, near Toowoomba in southern Queensland.



Wainui feedlot

The Farm

Initially, Wainui was purchased as a drought strategy, so that the company could de-stock drought-affected properties and still maintain production. It also enabled the turn-off of finished animals at a younger age and made it easier to meet the increasing demand of a consistent quality of product.

These days, approximately 65% of the company's cattle come through the feedlot, but they probably generate in the vicinity of 75-80% of the company's income. Most of the production is sold overseas, with only 20% used for domestic market demand. Roughly half of the beef goes to Japan, with 25% to the US. There is also a proportion of live export stock.

The feedlot is on an 1800 ha property. Silage is grown on the farm, in a 3-year, strip-cropping rotation, with a fallow period every second year.

At the time of interview, there were 89 ha of grain corn, 117 ha irrigated corn for silage and 85 ha of forage sorghum planted. A further 169 ha were planted for grain sorghum. Grain produced on the farm may be used in the feedlot, but if it is high quality it is usually sold (for example, barley may be sold as malting grain), and the proceeds used to buy in feed-grade grain for use in the feedlot. A number of native grass paddocks are also maintained on Wainui.

Around 0.5 ha of land around the feedlot was planted with trees about five years ago and another shelterbelt (approximately 0.3 ha) will be planted this year. At present, the exact mix of species to be planted is under debate, but it is likely that the species planted will be those that can be used for agroforestry purposes.

Case studies – Queensland

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The soils on Wainui are mostly black alluvials, except for a rocky section where the feedlot is situated. Most of the farm is flat (2% or less slope), but the feedlot has been built with an artificial slope of 3%.

There are seven houses on Wainui. A camping ground lies on the border and the town of Bowenville is 4 km away.

The Staff

NAPCo. employs an environmental officer (formerly Mark Ritchie, now Delphine Bentley). Part of the role of the environmental officer is to provide training for all the NAPCo. property managers in EMS.

In general the NAPCo. property managers have secondary education and all have completed the “Grazing for Profit School.” One of these managers has also attended agricultural college. At Wainui, two of the pen riders are completing degrees and the stud overseer holds an Agricultural Science degree. Several of the general staff have attended agricultural colleges. Senior NAPCo. managers all have tertiary training.

Wainui staff also participate in local and industry groups. Staff are members of, or on the boards of, Landcare, catchment management committees, Agforce, the Cattle Council of Australia and the Northern Territory Cattlemen’s Association.

The Environmental Management System (EMS)

The management emphasis on Wainui has gradually changed. The Wainui feedlot gave a new flexibility to the whole NAPCo. production chain. As the awareness of environmental issues increased, the environmental benefits of moving cattle off properties at certain times of the year became apparent and became part of a deliberate strategy.

The role of the company’s property planning officer also gradually changed, evolving into a full-time environmental officer. In the last few years the company has been working towards ISO 14001 certification, a significant task in view of all the properties involved.

NAPCo. recognises the need to move with community expectations in general. Geoff Kingston, Research and Marketing Officer for NAPCo., emphasises that because the majority of shareholders are family members, the existing shareholders have a custodial role for future generations. Decisions are made more on the basis of long-term sustainability than they might be if this was purely an investment company.

Having said that, the changes that are being made are definitely seen as a marketing tool. *“We use it to differentiate our product in the market place. We are relatively unique in terms of the level of integration that we have. We have control of the product from conception*

Case studies – Queensland

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right through to boxed beef. At the moment, customers are focussed mostly on QA and that is important. Some of the customers also look at animal welfare. For example, McDonalds now only want meat killed at welfare-friendly abattoirs and use welfare-friendly eggs! Environment is the next step.”

“The one-on-one contact of a large company such as ours with the end user makes the signals regarding environmental stewardship and expectations of that quite clear. Small producers who go through a middle man may not be getting the signals as clearly.” Geoff says that their customers are now more commonly starting to ask about the environmental friendliness of the production methods employed on NAPCo. properties.

Geoff Kingston, Research and Marketing Officer for NAPCo. sums up, *“The environment has gone from the back to the front page in the business papers. Talk to any of our managers and they are much more aware of environmental requirements than previously. While they are still cattlemen first, they are no longer cattlemen only. They are acutely aware that they manage the environment as well.”*

As an intensive livestock operation, Wainui is required to meet a number of licence requirements for air quality, water extraction and effluent disposal. In part, these requirements have shaped the EMS that has been developed.

The priority issues included in the NAPCo. EMS are:

- woody weed control
- water management and extraction
- manure waste management and disposal
- air quality and dust management
- chemical storage and management
- noise management in the feed mill and feedlot
- carcass disposal management
- pen management, odour and flies
- effluent waste management
- spilt feed management
- feral animal and vermin control
- native animal management
- soil conservation management.

These issues are being addressed on all of the NAPCo. properties, not just on Wainui. Each of the properties has a 10-year management plan, which clearly identifies management strategies into the future.

Many of the changes being made relate to the increased efficiency of resource use. Rotational grazing or periodic resting of properties is now the norm. The combination of environmental management and economic management is reflected in the environmental policy for NAPCo., which reads, in part:

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“Our natural resources of vegetation, water, soils and fauna are essential to the economic prosperity and social well being of the North Australia Pastoral Company.

The ability to sustain our prosperity is dependent on using our natural resources in an environmentally and ecologically sustainable manner.”

NAPCo. sees the use of the EMS as an effective way to integrate the management approach over all of the properties under its control. Geoff also describes it as “*staying a step in front of the pack.*”

NAPCo. operates three QA schemes, meets the National Feedlot Accreditation Scheme requirements, and follows Cattlecare and the Meat Standards Australia program. They also have their own occupational health and safety program, which has been formalised into manuals. The National Feedlot Guidelines and the Animal Welfare Codes of Practice were utilised when developing the EMS. NAPCo. is also participating in a Meat and Livestock Australia project, developing generic EMS approaches to be adopted across farms from Victoria to North Queensland and the Northern Territory.

The environmental officers for NAPCo. have sourced information from many places to assist with developing their EMS. Specific grazing and pasture management information came from the Queensland and Northern Territory Departments of Primary Industries. Queensland Department of Natural Resources staff were helpful and NSW Agriculture was able to provide specific information on EMS development.

Rivers have been fenced off and additional bores put down in strategic locations, so that cattle use more of the country. Cattle are now run in the river country for short periods only after floods. In addition, paddocks are fenced according to soil type for ease of management. This assists with the selective spelling of paddocks on a rotational basis. Changes in fencing have also arisen due to the need to control animals as part of brucellosis and tuberculosis control campaigns.

As a result of these changes, more cattle are being run on the same country for less impact. Properties are in better condition than previously, when cattle were set stocked. Grower properties are now destocked at the end of each season to about 50% capacity so that grasses have a chance to rejuvenate, ready to take the following year’s weaners.

On one of the properties, prevention of the loss of water through evaporation has meant considerable savings of this resource. Where previously there were open bore drains, water is now being piped. (up to 95% of water was lost to evaporation in the past.) Bores on other properties are generally controlled, but new bore placement is carefully managed to encourage cattle to utilise previously under-used areas.

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NAPCo. management also recognises the need to protect native vegetation and habitat areas. There are koalas and bilbies present on some of the properties and their habitat areas are fenced off to protect them from stock. A consultant has been employed to assist with the management of bilby habitat. The potential for carbon sinks presented by native vegetation is also valued and these areas are not cleared.

Tillage practices on Wainui and other properties have also changed. Minimum tillage is now the standard practice on NAPCo. properties.



Wainui compost heap. Before cotton farmers recognised its value, the stockpile was often higher than these trees!

Being the most intensive part of the enterprise, Wainui has probably undergone the biggest changes. When the property was purchased, the feedlot was in need of upgrading and there were frequent complaints from neighbours about odour generation. Much of the redevelopment work done on the feedlot in 1993/4 was in response to regulatory requirements and because of the need to better manage and control the impact on the environment. Since the redevelopment of the site, there have been no substantiated complaints about odour. A complaints register is maintained on Wainui as part of the feedlot licence.

Monitoring

Extensive monitoring occurs on Wainui, in many cases in excess of that required by EPA guidelines. Liquid effluent is sampled for residues, soil is monitored before and after applications of manure, and cattle feed stuffs are checked before being fed to cattle.

Monitoring results are continually being fed into management decisions. The records are kept on computer databases, with paper based versions also used. Some of the records have been built into decision-support systems. For example, with accurate rainfall data going back over 100 years for some properties, very accurate trend analysis of predicted ground cover and forage can be made. This information is then used to determine stocking rates.

The benefits of monitoring became very obvious last year, when, on one occasion, tests on sorghum about to be cut for silage showed chemical contamination from spray drift. The fact that the sorghum had been tested meant that contamination of the beef was avoided. The sorghum was allowed to mature through to grain, which gave time for the chemical to dissipate. Valuable market share could otherwise have been lost.

Case studies – Queensland

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ITEM	HOW OFTEN
Soil nutrients	Samples are sent to a laboratory before and after manure application; and prior to planting (approximately twice a year)
Liquid effluent	Samples taken from the pond annually (as a government requirement) or before use if effluent is being used for irrigation.
Woody weeds populations	Populations recorded before and after control spraying
Weather conditions	Weather station recordings, prior to any spray application
Residues in feed stuffs fed to cattle or sold	Samples of produce are checked (laboratory samples) prior to harvest of any silage or grain. Done seasonally
Residues in cattle	Feedback from abattoirs received as a continuous reporting
Rainfall runoff	Measurement done on an event-based program
Community amenity	Continuous monitoring of complaints register (includes wind direction and speed at time of complaint)

Schedule of monitoring activities

Benefits and Costs

Almost all of the work on NAPCo. properties has been funded from within the company; however, there has been some subsidisation of the water drain replacement scheme.

On Wainui, the feedlot and the surrounding farm were totally redeveloped and there have been no complaints about odour since then. In terms of improved relationships with the local community this has been a major benefit.

Solid waste is now composted and has become so popular with nearby cotton farmers that it is difficult to retain enough for use on NAPCo.'s own farm. It costs Wainui approximately \$15-20/tonne to produce composted manure and according to consultants, the equivalent fertiliser would cost about \$180/tonne. The manure now forms a source of income, with local farmers keen to buy it. Geoff points out that the value of this manure goes up in local farmers' eyes when they realise that it also adds valuable organic matter to the soil, assisting with moisture retention on the sandier soils. This, in turn, saves them in irrigation water costs.

"We are now running more cattle on the same country than ever before, which means that our overall production in terms of throughput of beef produced per year has increased", says Geoff. This has happened without increased impact on the environment, through more careful use of pastures and selective destocking and use of the feedlot facility.

Overall, Geoff estimates that the whole EMS effort across all the properties has probably cost around \$20,000. There are additional costs to come in the future, when the company undertakes certification audits. Staff training in EMS will also contribute to costs.



Cattle typical of the northern properties, soon after entering the feedlot

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Geoff believes that without the changes made, the potential costs could have been huge. He states that their product would have decreased in value, as it would not be acceptable to their best customers. An important part of maintaining that market attractiveness is the ability to use the feedlot. He also sees using an EMS as a competitive advantage and recognises that the company structure of NAPCo. is particularly suited to using an EMS approach.

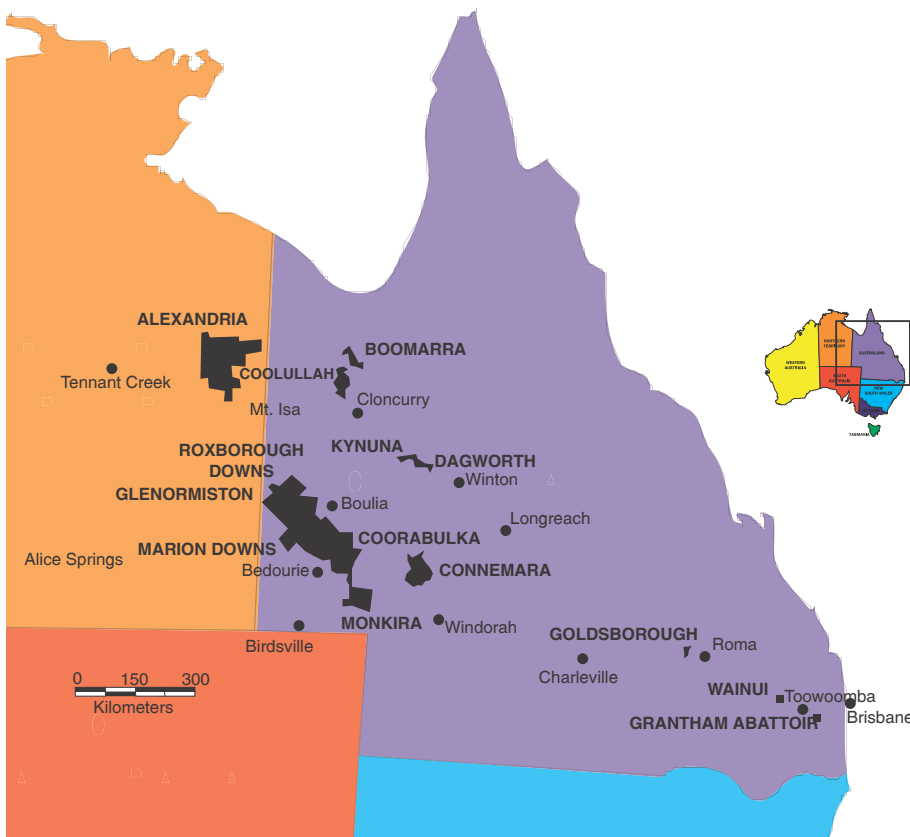
Future of enterprise

The changes made by NAPCo. are mainly in response to regulatory pressure and consumer demand, so the company is confident in their future and that they are headed down the right track. Geoff expects that their direction will continue to be influenced by the demands of the community and Government.

In the future, Geoff believes that being able to provide a certification to attest to the responsible environmental management employed will become increasingly important. He sees the EMS as a way of being able to verify claims of environmentally friendly production.

However, he feels that adoption of EMS must remain a voluntary option. *“People get their hackles up if you try to force them. If you make it compulsory they will resist for the sake of resisting.”* He believes industry and Government agencies should work together to provide information in such a way that people can see the link between profitability and sustainability.

He believes that issues such as greenhouse gases, ozone depletion and carbon credits will become more significant in the next 20 years.



Map showing locations of NAPCo. properties.

Case studies – Queensland

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Pacific Coast Bananas

Eco bananas find a niche market

Frank and Diane Sciacca

Pacific Coast Produce is a small banana plantation near Innisfail in North Queensland. It is a family farm, purchased by Frank and Dianne Sciacca in 1982. The Sciacca's recently began to develop an EMS based on the international Standard ISO 14001 and intend to gain certification against that Standard in the future.

The Farm

About 40 ha of the 50 ha property are used to grow bananas and 1 ha limes has recently been planted with limes. Approximately 9 ha were fallow at the time of interview. There are no creeks or riparian zones on the farm. Rainfall is mostly monsoonal, falling in summer.

The farm was originally used for sugar cane production. However, Frank felt that there was no future in the cane industry and so moved into banana production. The heavy machinery use in cane farming had created degraded soils in some areas of the farm. Since Frank and Dianne moved into banana production, they have been working to improve these degraded areas.

It is a flat area, with alluvial red soil and no significant drainage systems present. The site was deliberately chosen, partly for this reason, as a location where banana production could be safely undertaken without there being any obvious adverse effects on the environment. The move from cane to bananas has seen the start of irrigation on farm and fertigation is used when the weather is appropriate.

Frank believes that most of the banana industry is production driven, maintaining profits by increasing the number of bananas they produce and by feeding the trees to maintain maximum production. In an unpredictable climate, where crops can be wiped out by cyclones and with fluctuating market prices, Frank questions the wisdom of outlaying so much money on fertiliser.

Also, he believes that if you put on huge amounts of fertiliser to supply one nutrient, say nitrogen, when it is not necessary, you may throw your soil out of balance in some other way.

Frank does not believe that it is natural, or environmentally friendly, to push a tree to produce the maximum it is capable of 100% of the time. *"Pushing production probably stresses the tree and makes it more susceptible to disease"*, Frank says. He decided to see if he could reduce his inputs and still remain viable.

Authors:
Belinda Walker and
Genevieve Carruthers



The Sciacca's farm is near Innisfail, in Queensland.



Frank and Dianne Sciacca inspect a developing bunch of bananas.

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The Staff

Frank has been farming for 19 years and has past training in the electrical trade area. Dianne has previous office management and administration training. She is currently completing a degree course.

The number of staff on the farm varies depending on the season, but is usually around 10. In the height of the season, staff numbers can increase to around 20.

Frank and Dianne have completed Future Profit training provided by the Queensland Department of Primary Industries (QDPI) and have also done various business planning, marketing and financial courses. Use is made of local seminars and workshops as they occur. Frank and Dianne are members of the Johnston Shire River Catchment Group and the Queensland Fruit and Vegetable Growers Association.

The Environmental Management System (EMS)

Frank and Dianne have completed an environmental impact review and have identified 33 items that are addressed under their EMS. *“Basically, we have employed what really is a fairly simple system, once you overcome the mindset of conventional farming”*, they say.

The highest priority issues are reduction of nitrogen and other fertiliser inputs, reduction in pesticide use and increased use of integrated pest management. These issues were recognised in a variety of ways. Discussion with other farmers, regulatory agency and QDPI staff all flagged areas of concern. The Great Barrier Reef Marine Park Authority has targeted nitrate inputs into the catchment as a significant issue and this has in turn highlighted the use of fertilisers for many farmers in the district.

Frank uses less fertiliser and monitors more intensely, compared with most people in the banana industry. He tries to match his nutrient input in fertiliser precisely to the amount of nutrients that are taken off in the bananas.

The use of fertigation through the drip irrigation system helps in controlling the release of fertilisers. Frank believes that fertigation gets to where it is needed more quickly, rather than putting on solid fertiliser which sits on the surface and is more likely to leach. Over time, Frank says he will probably rely more and more on the fertigation method. *“We are also putting a fair bit of nutrient back into the soil in the form of mulch”*, Frank says.

Frank also says *“We are not growing trees here, we are growing bananas.”* His trees may not be as big and lush as the industry norm, but his return on his investment is proportionally greater. *“Do we really need all that growth to produce bananas? Is all that fertiliser cost effective? I don’t think so and we are trying to work out just what the trees really do need to be healthy and produce reasonable fruit. That’s the amount of nutrient that we need*

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to give them.” Frank does not necessarily allow all suckers to grow through to bunch development. If suckers develop at the wrong time of the year for the bananas to be grown economically, he will cut that sucker and cut his losses. Thus, his production volume is down, but because his costs are down, he is still viable.

Frank does not push the trees for optimum production. Because of this, the bananas tend to be smaller, but also have more flavour – according to surveys conducted with repeat consumers.

Herbicide use has also been significantly reduced. Slashing is now the preferred method of keeping grass down in the inter-row areas. *“From a traditional farmer’s perspective our farm is messy. But from our perspective, it is a clean and green farm”*, Frank states.

Frank is also working to reduce his pesticide applications and uses integrated pest management. Now that ants, other insects and spiders have returned to his plantation in large numbers, he finds that these are biological controls for certain pests that attack the bunches. The increased herbage left between rows provides habitat for beneficial insects, as part of the integrated pest management program. These insects are also conservation indicators. He has now stopped bell injection altogether and finds that his bunch losses per week are insignificant. In future they hope to use a pest strip if necessary, attached inside the plastic bunch cover to deter insects. This will avoid any chemical actually being applied to the fruit.

The move from cane to bananas was a significant factor in the increases noted in biodiversity. *“There is no annual harvest in bananas, we leave a lot of habitat behind. Also the climate inside cane is very different to that in the bananas.”*

Further improvements to chemical control have been made in the application area. *“We now apply fungicide (for Sigatoka disease) from ground rigs –this cuts back on aerial applications.”*

The Sciacca’s recycle almost everything on the farm and have been active in canvassing plastic manufacturing companies to “do the right thing” and take their plastic back. The EPA has now taken a hand in this and the plastic companies are starting to cooperate. The ‘waste covenant’ that came out in July 2001 in Queensland saw a big turnaround in attitudes of companies in taking responsibility for recycling/return of their products. Greases and oils are also recycled, as is all cardboard.

The Sciacca’s have commenced composting all food wastes on the farm and the compost is returned, via worm farms, to the banana trees. The composting and recycling programs have enabled all staff on the farm to get involved. They are currently setting up commercial worm compost to recycle all the biological waste



Sprays are no longer used between the rows to keep the grass down. This encourages insects back amongst the trees, which helps to control pests.

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produced by the organisation. Trials are in process to evaluate the feasibility of such a system.

Frank and Dianne recognise the need to have their environmental endeavours officially recognised and in the last couple of years have been working towards ISO 14001 certification. They acknowledge that they are luckier than some farmers in the area, in that their farm lends itself to relatively easy certification. They believe that some people in the area, whose farms are on steep country and/or closer to major drainage systems, may find it difficult to address environmental issues. *“If you looked at your farm and found that you couldn’t achieve ISO 14001 certification, you wouldn’t have any confidence in the future, would you?”*

Frank and Dianne used the Queensland Fruit and Vegetable Growers Association ‘Farmcare’ and the Queensland Farmers Federation ‘Environmental Codes of Practice’ when developing their EMS. They also use HACCP; an agent preferred-supplier QA and a self-developed QA program. They believe that these approaches should all be integrated with the EMS, as there are a lot of areas of overlap and cross-reference.

Monitoring

The implementation of the EMS has built on monitoring that the Sciacca’s were already doing on their farm. Monitoring is mostly centred around the inputs that are used on the farm.

ITEM	HOW OFTEN
Fertiliser inputs	Units per ha of NPK or trace elements applied are recorded on application
Insects, frogs and other animals	Physical inspections and counts are made weekly
Chemical inputs	Records are kept of applications
Waste streams produced	Weekly measures taken
Water use	Weekly recording Sept – December, soil moisture tests taken
Frogs coming in, in bunches	Continuously during harvest
Financial records	Assessed monthly

Schedule of monitoring activities

The farm production and management are analysed monthly and there is an EMS review every six months. Records are kept on both paper and computer formats, with the programs MYOB and Excel used for records.

Dianne and Frank now find it easier to use and compare records that they keep. They have developed customised spreadsheets to make this easier. Being able to draw in records from all areas of the business has been useful in meetings with other growers who want to join the ‘Eco banana’ team. *“They wanted facts and figures and now we can show them”*, says Dianne.

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Benefits and Costs

The Sciacca's believe that by paying more attention to environmental management, they have gained more control over the whole production system. *"We recognised early on that one of our major goals was to avoid a situation where you put money and effort into producing something, but had no guarantee of prices or returns. With growing cane, we were caught in a system where we had lost control of the product – this was no good for us, no good for the land and we didn't want to keep going that way. We could see the banana industry heading the same way and realised something had to change."* Frank and Dianne say that they are now using half (or sometimes less) the industry average input for nitrogen. This represents a significant saving in inputs.

Soil cores recently taken from the farm by the Queensland Department of Primary Industries showed that the biological activity and diversity of the samples was equivalent to soils taken from rainforests in the area. Frank says that he can actually see the improved condition of his soil – the soil structure is greatly improved from the cane farming days.

Apart from reduced costs, there have been other benefits from implementing this changed production system. The main one has been the development of a niche market for 'Eco bananas.'

Dianne Sciacca is the marketing arm of the partnership and has personally visited shops around Sydney when developing this market. Areas where quality was likely to be more important than price were deliberately targeted and Dianne requests that marketing fliers be placed at the point of sale and that a fact sheet is available for the purchaser. She has also provided written information to the agents so that they know what the product is about.

The market research Dianne has done discovered that 95% of customers said that they would buy the fruit again, with many reporting that they liked the smaller size and better taste of the 'Eco bananas'. A significant number said that they would pay more for 'Eco fruit'.

'Pacific Coast Eco Bananas' are supplied to Harris Farms, who have 12 stores across Sydney. Although the product was only introduced to the market in September 2000, the sales of Eco bananas had jumped from 25% to 45% of total sales in some Harris Farm stores in two months to January 2001. At that time, they were receiving \$6/box premium above what the rest of the industry were getting for their bananas.

Sciacca's have been surprised and elated by the demand for their 'Eco bananas' and are having trouble keeping up with the demand. They now have several other growers interested in joining them and adopting their production system.

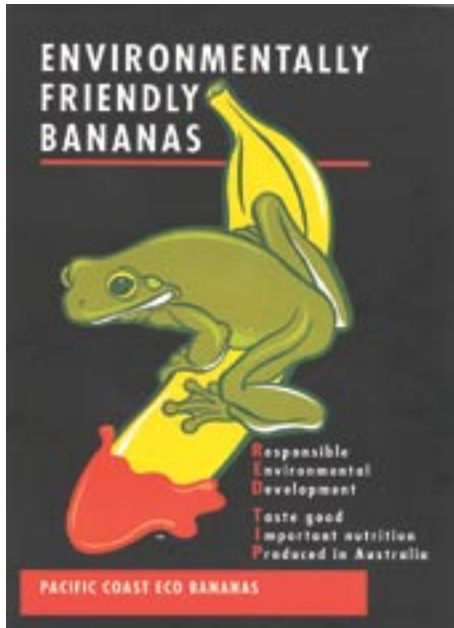
Frank and Diane have made it a prerequisite for anyone joining the team that they do an EMS; anyone who is given permission to use their patented "eco tip" symbol must get ISO 14001 certification and implement their 'eco production' system. Sciacca's feel that this will ensure that these farmers also have a genuine desire to be environmentally friendly and are not just in it for the money.

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Although the Sciacca's sell their fruit on the domestic market at present, they are working on marketing to Japan, Singapore and Hong Kong. They hope to work with the Supermarket to Asia program to develop these markets. The red colour used on the tip wax of the fruit coincidentally signifies 'good luck' in those countries and so may provide an added marketing advantage.

An unexpected benefit of this success has been that instead of being regarded as a bit of a joke, the Sciacca's are now recognised as people worth consulting within the industry. Others are starting to realise that their approach has merit. Frank says his non-farming neighbours are impressed with their good practices, but adds that some of the local farmers feel that the EMS is a threat. *"Outsiders and customers have an improved image of the industry now"*, says Frank.



The 'Eco bananas' logo: the red tip has been patented.

Dianne and Frank also feel more confident in their management. *"Although Frank has been doing weekly monitoring for over three years now, it's only in the last year that we have been documenting all that."* This monitoring and documenting allows the Sciacca's *"to get things right the first time, making sure that things get done efficiently and effectively."*

Frank and Dianne recently participated in a benchmarking exercise across 20 banana farms in the industry. *"Although I came last in the overall production area, I was actually third when return on assets managed was assessed"* Frank notes. *"I showed that you can still be viable without having the highest level of production."*

The health and safety of farm workers is another area that has benefited from the EMS development. Frank does all the mixing of chemicals and most of the chemical applications on the farm. Farm staff apply chemicals only in low risk situations. Access to the chemical sheds is restricted to Frank.

Costs have mostly been in the form of more management time required. *"You have to be more hands on, keep on top of it and do monitoring and manage your crop better"*, says Dianne. They also employed a consultant when they started to document their EMS and have found this one-on-one interaction very useful at that stage of the EMS development.

Frank and Dianne pay themselves a formal 'wage' from the profits of the farm and so can estimate what their time has cost for the EMS development. Some of the costs incurred included paying the consultant, employing new staff, infrastructure and capital works, training, administration, software and computer costs. Dianne estimates that they have spent around \$26,000 over the course of their EMS development in the past two to three years. This figure includes their own time inputs. She adds that there will be auditing costs when they proceed with their EMS audits.

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A final area of cost is one that is also providing the market differentiation. At present, Frank and Dianne are dipping their bananas in the red wax by hand and this involves additional staff time and cost. They are looking at mechanising the process, working with Amcor Company to develop the process. They plan on making the mechanised process available to other farmers who begin to work with them on the 'Eco bananas' program. *"We've done this not only for ourselves, but also for other farmers who genuinely want to be more environmentally friendly"*.

The Future

The Sciacca's hope to continue to improve their production system along the same lines that they are pursuing now. Dianne believes that there will be greater use of technology and records in the business, as they continue to improve the information processes from data collected.

Frank suggests that the Government should encourage the development of an 'eco-levy' system (perhaps 10c/box of bananas) which the producer could put on his own product and donate to the environmental cause of his choice, or into research and development of their own environmentally friendly product.

"Government bodies such as the EPA must get out onto farms and talk to people, go into the farmers' environment where they feel at home and talk, not just invite them to meetings and expect them to listen. Communication must be improved and future requirements, in terms of the environment and their likely impacts on farmers, explained."

Frank and Dianne are quite confident that they are heading in the right direction. The feedback that they have received from the market place proves that. And their success suggests that, with proper marketing and promotion and a means of clearly differentiating the product, it is not unreasonable to expect a premium for "Eco produce."



Part of the reason for the success of the 'Eco banana' is undoubtedly the red wax tip, which immediately differentiates it in the marketplace.

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Authors:
Belinda Walker and
Genevieve Carruthers

Bolinda Estates

Leading by example in the Australian banana industry

Steve Mackay

Bolinda Estates is one of four farms owned by the Mackay family, based near Tully, south of Cairns in Northern Queensland. The family partnership bought the 1498 ha property when King Ranch was split up in 1990 and has been progressively converting some of the grazing land to banana plantations. Approximately 285 ha are still native rainforest and the Mackays have re-treed and revegetated some of the riparian areas. They have planted over 400 ha of bananas on Bolinda Estates and fatten approximately 720 head of cattle. The Mackays also own three older banana plantations of 485, 566 and 810 ha. Their fruit enterprise is covered by the SQF 2000 program.



Steven Mackay with a bunch of immature bananas



Bolinda Estate is located near Tully in far north Queensland.

The Mackays employ 180 people year round, 200 at the height of the season. They are the largest employers in the district, even ahead of the sugar mill! Ninety percent of farm income comes from bananas and ten percent from cattle.

The Farm

Bolinda Estates is situated in a valley beside the Tully River and is surrounded to the north and west by World Heritage listed rainforest and to the south by the riparian forest bounding the Tully River, which runs out onto the Great Barrier Reef. They are at the top of the catchment, receiving water straight out of the rainforest.

Soils are mainly alluvial with underlying granite boulders. Both coarse and fine sands are present along with some red soil.

The property is situated in one of the wettest areas in Australia with an average annual rainfall of 7000 mm. Thus water management is their major issue. Steven Mackay says “We irrigate for two to three months of the year and spend the rest of our time trying to get rid of water.”

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The Environmental Management Program (EMP)

At present the farm is developing its own EMP, but may move to ISO 14001 in the future. As a result of research on the Standard, Steven says that he has become more aware of the products used, recycling and packaging issues and has taken these issues more into account in his current planning. For the present, however, they are not pursuing implementation of an EMS to this Standard.

Steven feels that their initial impetus to change came from the success of bell injection. *“It was such a dramatic change in chemical usage and so successful, that it stimulated us to look at all our other practices to see what else we could improve.”*

“Also we are very aware that if we don’t want bureaucracy coming along and telling us what to do, we need to ask the questions first. We would much rather question everything that we do and make a start on fixing any problems. Then when bureaucracy comes along, they can see we are at least trying to do the right thing. Then they are more likely to say “Can we help you?. That’s a much better way to attack something.”

There is a huge potential to pollute water with fertiliser and various other chemicals in the area, if these issues are not properly managed. Timing of chemical application in relation to water application (irrigation or rain) is critical.

Where possible, the Mackays use “fertigation” – application of fertiliser in trickle irrigation. In the wettest months of January, February and March, there is no fertiliser applied and at other times it is applied in small amounts, to reduce the risk of run-off if there is a large rainfall event.

Runoff from the banana plantations goes through ponding and a series of planted, grassed up areas, to filter out any chemicals. Water leaving the farm is monitored after fertiliser application, before it reaches the Tully River. No problems have been detected since this system was set up.

The next most important issues are the reduction of chemical use and the use of integrated pest management. Steven regards the advent of bell injection as a major leap forward for the banana industry. Bell injection involves the injection of small amounts of insecticide into the “bell,” or flower of the banana plant, inside which the bananas will later develop. By using this technique, insecticide usage has decreased from potentially 50 L/ha/year to less than one L/ha/year.

This prevents the attack of scab moth and thrips, which can ruin the fruit. Prior to the advent of this technique, huge amounts of insecticide were aerially applied to bananas, killing non-target species as well as the pests, creating a biological desert amongst the banana plants. With most of the predators destroyed, aerial spraying of insecticide had to be followed by the use of a miticide as well, to kill mites. Now the insect population is more in balance and there is no need for this. The banana plantations are now also full of frogs and birds that feed on the insects.



Bell injection: A small amount of insecticide is injected before the fruit develops, using a specially designed apparatus attached to a long pole.

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Steven also regards maintenance of quarantine to exclude certain diseases as a major factor in reducing chemical use. A major problem in bananas is a parasitic nematode that attacks the roots. By introducing clean nematode-free stock to the new farm, Steven has avoided the need to use the most toxic chemical in the banana growers' armoury, for the past 10 years.

Some fungicides are still used but, as part of their IPM program, the Mackays are now testing each season to see if fungicide application is actually necessary, rather than applying it routinely.

Other changes that have been implemented on Bolinda Estates include the management of the ground between the bananas. Previously, chemical companies claimed that chemicals to control nematodes and weevil borers needed to be applied to bare soil. This led to the practice of clearing leaf matter away from the trees. This has now been found to be unnecessary and the leaves are now mulched around the base of the plants. This improves water and chemical retention on site and reduces erosion potential.

The variety of soils on Bolinda Estates has made the Mackays more aware of the need to treat each soil type differently. Tillage practices are varied according to soil type.



Cattle picking through the reject bananas dumped in their paddock

Cattle stocking rates are much reduced compared to what they would have been when the property was part of King Ranch. Also, rotational grazing is now practised and Steven finds that the cattle grow out better. All the reject bananas and banana waste is fed to the cattle and they love it. CSIRO is working with the Mackays to see what needs to be added to banana waste to make it more like a feedlot ration, so that cattle weight gains on it can be improved.

"Also, in such a high rainfall area, we can tread all our feed into the ground in the wet months of the year, so we are conscious of avoiding high stocking rates at that time of the year".

Prevention of pollution is now a part of the management approach. The polypropylene string and bunch covers that are used to cover and tie the bananas are brought back to the shed as the bananas are harvested and are sent to a recycling plant.

Frogs are recycled too! Frogs coming into the shed on the bananas are identified, counted and returned to the field.

The family has made most of its changes through consultation with industry and then has refined techniques to suit their own management system. The banana industry employs a Liaison Officer in Tully, who passes on all relevant information and liaises with bodies such as the Queensland Fruit and Vegetable Growers (QFVG). Steven believes this system works well. *"He gives us the potted version and we can then follow the issue up if it's relevant to us."*

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Steven believes that talking one on one is the best way to obtain information. His consultant, Richard Piper, says that a lot of neighbours come to the Mackays to learn about environmental issues. Steven agreed that they had an open house policy. *“We encourage that sort of thing because, although they see what we’re doing, we also get enough information out of them for it to be a two-way street.”*

Monitoring

A weekly meeting is held where farm management issues are discussed and a fortnightly meeting is held with the business’ contract entomologist.

ITEM	HOW OFTEN
Soil fertility, nutrients, pH and heavy metals	Soil tested in laboratory bi-annually.
Fertiliser and pesticide residues in run-off water (monitored at the point it leaves the farm)	Samples tested in laboratory bi-annually. Samples are taken after the largest chemical applications. Another sample is taken after the wet season.
Leaf analysis	Samples tested in laboratory bi-annually.
Frog counts –transects	Every 3 months, 3 x 200 m transects
Frog counts – in shed, as they come	Continuously during harvest

Schedule of monitoring activities

As the monitoring results are received on a six-monthly basis, a more intensive review is done at those times.

Most of the farm records are kept on paper as farm diaries, but some use is also made of computers for record keeping.

Benefits and Costs

The Mackays believe that the changes instigated have meant that they have moved from the top 30% to the top 10% of banana producers in the last 5 years. Steven estimates that this means a 10-20% increase in profitability.

The extent of the benefits, in many cases, came as a surprise. *“Once you get on the roller coaster of wanting to address all the issues you think are wrong or hazardous to the environment, and once you start addressing them, I don’t think you fully understand how easy, how big the gains are each time you get things right. We had no comprehension that we could make so many gains in such a short period of time, with not necessarily such a large investment. We were thinking it was going to be harder than it was”.*

“For example, when we started rending the trash back around the base of the plants, we found that the water leaving the bananas was clearer, less herbicide was required in the bananas because of the mulch, and the trash blanket physically excluded light and reduced weeds in the inter-row area. There was better fertiliser retention and water retention because you have got mulch there. For every practice we changed, there wasn’t just an immediate benefit that you knew was going to happen, there were also repercussions that you didn’t understand at the time. You

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expected only small gains that you knew were going to happen and all these other benefits came along and that was why it was all so exciting. So you want to get on to the next innovation and find out what else could also be changed.”

Another benefit of the changes has been the change in attitude of the community to banana growers. Steven believes that they are now generally seen as environmentally responsible, which has obvious social benefits.

But the ultimate benefit is peace of mind. *“I think all of us can go home each day believing that we have done the best we can, with what we have been given. That gives you peace of mind.”*

The costs of change are hard to estimate, but Steven is confident that the benefits far out-weigh the costs. For example bell injection is very labour intensive – Mackays

employ 8-10 men who do nothing else. “In the beginning, the straight out aerial spraying compared to men on the ground doing bell injections, did seem more expensive. But now that we appreciate the whole system and have seen the better control of our pests by insect predators and the premium we now get in the market place, you would never ever go back the other way. In reality, it was probably costing us more back then, before we changed.”

“Also, it cost us to employ the consultant who told us to mulch around the trees, but changing that practice has saved us heaps more - \$600 per hectare in labour for a start, without the flow-on benefits.”



Young banana plantation growing on the edge of the rainforest.

The Future

Steven believes that management systems such as QA, OH&S and environmental systems should, if possible, be integrated into one package. *“If all staff and family members really want to participate in what you are doing, they need to understand everything you are doing. It should potentially be all one big system so everyone takes it on board, instead of some people just being involved with the quality part and some people just thinking the safety part is most important. Your staff should take ownership of all of it not just parts of it”.*

“I don’t think you can separate quality and environment. People should look at the big picture every time they do anything. That’s what we do personally as owners of the business.”

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Rocky Point Prawn Farm

Meeting community concerns about aquaculture

Rohan Koenig

Author:
Genevieve Carruthers

Rocky Point Prawn Farm comprises 20 ha of ponds on a 40 ha site near Woongoolba on the southeast coast of Queensland. The farm is owned by Trevor, Keith, and Murray Zipf and it has been in the family since the late 1800s. It was previously used for cattle and cane production. The ponds were established in 1988 farming red claw and marron, with prawns first farmed in 1991. The change to aquaculture from cane came about because of the better returns and the area under ponds has increased gradually over time.

The kuruma prawns are sent to Japan or other parts of Asia, while the black tiger prawns are grown for the domestic market. The recognition of the EMS standard ISO 14001 in Japan is very high and probably provides a market edge to the Rocky Point product, though there are no clear market signals at present.



Location of Rocky Point Prawn Farm

The Farm

Cane farms surround Rocky Point Prawn Farm and there are numerous tea tree and paperbark swamps in the vicinity. Tea tree and paperbark swamps bordering the farm receive effluent from the nearby sugar mill. Some cabbage palms and sparse Eucalyptus make up the surrounding vegetation communities.

The farm is located in an estuarine area but there are no defined creek lines, only artificial drainage channels from the cane farms. Creeks may have existed prior to the development of drainage channels.

Mangroves adjoin the property where intake and discharge pipes are located and there are residences on neighbouring properties within 100 metres of the boundary. In the past, some of these neighbours have complained about noise, lights and dust associated with night-time harvesting of the ponds.



Rocky Point Prawn Farm (arrowed) is on the edge of Moreton Bay (at right) and surrounded by cane farms and other aqua-culture enterprises.

The Staff

The business employs 11 permanent staff and up to 25 casual staff during harvesting and packing. Farm manager Rohan Koenig came to Rocky Point from the CSIRO and has an extensive background in prawn nutrition research and management. There is also a maintenance manager on site and administration support.

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The partnership has a board of directors and is closely aligned to the industry body – the Australian Prawn Farmers Association (APFA). One of the directors of Rocky Point Prawn Farm also serves as a board member of the APFA.

The Environmental Management System (EMS)

Rocky Point Prawn Farm is committed to environmental management in line with the Environmental Code of Practice for Prawn Farmers released in November 1998. They are developing an EMS based on ISO 14001, which will be integrated with their quality assurance program.

The motivations for putting an EMS in place were to address public concern and meet regulations that apply to the industry. Having an EMS was seen as a way to deal with obtaining development approval for the farm and addressing negative public comments. The local office of the EPA has taken a hard line with prawn farms in the region. *“The Queensland EPA was also promoting EMS and provided stimulus and support for ours to develop”*, says Rohan. A desire to improve the management of the farm also influenced continuing the EMS development. The support of the EPA and the prawn industry has been important. Apart from consultants, there was little other assistance available.



The Rocky Point Sugar Mill (background) is on the western border of the prawn farm. Water wheels (left foreground) aerate the ponds.

There are concerns about the impact of the prawn farm on neighbouring properties and, similarly, the activities of cane farming impact on the prawn farm. Run-off from cane fields into intake and discharge channels cuts the farm off from salt water, and can lead to fish kills and increased biological oxygen demand (BOD). This in turn affects the quality of water entering the ponds.

Problems can also occur due to soot and effluent water from the nearby sugar mill entering the farm's intake water.

The EMS has been built on the prawn farm's existing environmental management program and is integrated with the quality assurance and HACCP programs used in the processing plant.

The EMS addresses potential impacts on water quality and the marine ecosystem, noise (from harvesting and paddle wheels), lights, land contamination, air quality (dust), energy use and some waste issues. There are fairly strict regulations covering water, air and land contamination that the farm must address in its EMS.

Storm water is prevented from entering the farm in order to maintain the necessary salt levels in the ponds. The current aim for saltwater use is to increase recirculation through the use of treatment ponds and to reduce nitrogen levels. The treated saltwater from the ponds will form the discharge from the farm.

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The development of the EMS has not led to major changes in practices on the farm. “It was really a case of documenting current practices and improvements made to the monitoring on the property”, says Rohan.

The system of water reticulation on the property is presently being altered. Energy audits and water sampling have helped to pinpoint areas where improvements could be made.

Acid sulfate soils (ASS) are present on the property and are an area for concern. However, the development of the ponds is such that the ASS layer is not disturbed. Ponds are built up, rather than into the soil and are regularly desludged, with sediments being used in the construction of new walls and ponds.

Monitoring

Records at Rocky Point are maintained using a combination of computers and paper. Regular management meetings are held with a major annual review held when ponds are restocked, usually in November.

ITEM	HOW OFTEN
Samples on inlet/outlet water – N, K, pH	Laboratory analysis is done on water samples twice a month
Ammonia in ponds	Each pond is sampled fortnightly
Salinity, temperature, dissolved oxygen, pH, turbidity in ponds	Morning and night samples are taken with a Yeoval water quality meter
Diesel and petrol use	Use rates are reviewed weekly
Energy consumption kW and amps	Monthly amperage Weekly motor and gearbox readings
Training	Program and register as needed
Financial	Annual review

Schedule of monitoring activities



A dry pond, awaiting desludging and reworking

Much of the monitoring that is done relates to the water quality and stock health. The other areas of monitoring tend to focus on the efficiency of energy use and have resulted in production efficiencies.



Experimental water filtration units are being tested on the prawn farm.

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- Wainui Feedlot
- Pacific Coast Bananas
- Bolinda Estates
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Benefits and Costs

“The adoption of an environmental management system has led to better yields and profits from the farm”, states Rohan. “Risks are now more clearly identified and it is much easier to meet regulations set by the EPA.”

The resources upon which the prawn farm depends are in better condition and more closely monitored. This has led to improvements in the health of the stock and consequently better yields. Less feed is wasted now and the production process is more streamlined.

The development of emergency plans is seen as an important element for both staff safety and preventing any environmental harm that might arise as a result of accidents.



Rohan Koenig with one of the 'Opera House' nets used for harvesting the prawns

There is greater confidence in the management of the farm and the overall industry image in the area has improved with the changes made. More importantly for the business, relations with the surrounding community, local Government and neighbours have improved. It is still early, however, to assess the impact on market access and prices.

Whilst the environmental benefits identified relate mostly to the condition of the water resource and the health of stock in the ponds, Rohan doesn't believe that all the benefits have become apparent. *“We are still unable to assess all the benefits from changes made; it will take a number of seasons to determine where cost savings have occurred and how management has improved. While we recognise that there are production savings, it is too early to really pinpoint these yet”*. Prior to the development of the EMS there were no records or documentation with which to manage and review this section of the business, so records are still fairly recent and data is still to be collected.

Another major benefit is the ability to keep operating the business at the current site and not have to move elsewhere. Rohan believes that relocation would have become inevitable if the community concerns had not been addressed. *“That would have been a really costly exercise and now we don't have to worry about it”*.

The Queensland Environmental Protection Agency is supporting the business in the development of the EMS and will do so right through to the certification process. The Queensland EPA paid for a gap analysis (conducted to determine where the existing management plans did not meet the ISO 14001 requirements) by a consultant. The consultant provided a report detailing how these deficiencies could be redressed. Energy audit costs were covered by the Greenhouse Challenge and the CSIRO conducted water-quality monitoring.

The main costs associated with the EMS have been in achieving the required water

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quality and nutrient levels. These costs are also part of meeting quality assurance requirements. Without addressing these issues, stock health is put at risk and so Rohan does not see this as an additional cost to the business.

The ISO 14001 audit costs will be minimal in comparison to other costs. The quality audits currently cost around \$3000 per year and it is anticipated that EMS audits will be done in combination with the QA audits.

In the general development of the site in recent years, consultants fees, infrastructure and the purchase of capital equipment have meant significant costs. More staff are now employed and monitoring and administration costs have increased.

The Future

Rocky Point Prawn Farm is now seeking ISO 14001 certification to accompany their ISO 9002 status. Although Rocky Point Prawn Farm didn't go down the ISO 14001 EMS path for marketing reasons, Rohan hopes they can gain market benefits from the certification when it is obtained. Rocky Point Prawn Farm already highlights their ISO 9002 certification in marketing and they plan to do the same when they achieve their ISO 14001 status.

For other similar businesses looking at EMS, Rohan recommends using a consultant and learning from the experiences of others. A guidebook to EMS would have been greatly appreciated when Rohan began to develop the EMS.

Rohan believes that reductions in licence fees and an easing in reporting requirements would help entice others down the same path. Rohan would like to see parts of the EMS fulfil the reporting requirement for the business to the Queensland EPA, lessening paperwork.

Having an EMS in place, with its associated emphasis on monitoring and records, will mean that Rocky Point Prawn Farm is well placed to meet increasing community and government accountability requirements for farm management practices. Public relations about aquaculture will take time to address, but the management of Rocky Point Prawn Farm is confident that their EMS will help them to demonstrate the responsible environmental management that is being applied at the site.



The new water storage and treatment dam will mean that all water from the ponds can be contained on farm and treated before release into Moreton Bay.

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Author:
Genevieve Carruthers

Rivendell

Aiming to maintain a balance

Mick McGinnis



The farm in 1981 – note very low levels of vegetative cover



By 1998, an increased number of dams and vegetation are apparent, as are contour banks and mounding to control erosion.

Mick McGinnis has operated the property Rivendell since 1983. He has aimed to achieve improved cover of native vegetation, control run-off and erosion and improve soil fertility under his orchards of low-chill stone fruit and persimmons.

The Farm

Rivendell is located near Woombye, in the sub-tropical Sunshine Coast area of Queensland.

The farm was originally untimbered pasture and was used to grow bananas and pawpaws when Mick took it over. Bananas were gradually replaced with stone fruit from 1994, with the first persimmons planted in 1996. This was done because Mick could see future problems looming for the banana industry and he took the opportunity for domestic niche marketing that stone fruit presented. Persimmons were chosen because their cultural requirements fitted into the ‘down-time’ for stone fruit production. Persimmons have similar management requirements to stonefruit and are an export crop. The main watering requirements of persimmons and stonefruit also fall at different times, which reduces peak demand for water.

The property covers 19 ha with 5 ha of low-hill stone fruit and 1.5 ha of persimmons – 7 ha of the orchards are netted. Cattle are run over 8 ha (and are used for weed control over 4 ha of revegetation areas). Shelter belts and corridors occupy around 2 ha with a further 2 ha of native vegetation present.

The majority of the farm income is derived from the stonefruit enterprise, but Mick is currently establishing a farm contracting business that will also generate income. Landcare support has been received in the form of a small number of trees and Mick has also won some cash prizes through Landcare (the Landcare Primary Producers Award, in 1997) and the Queensland Fruit and Vegetable Growers Association, which he has put back into environmental management on the farm.

Soils on the farm are gravelly clays, basalt and brecciated rhyolite and cracking self-mulching soils. The local area also has some volcanic soils present. Much of the farm has a northerly aspect and slopes can go up to 20% in some areas.

On the farm, there are forest red gums along Petrie Creek, which forms one border of the property. Pockets of wet scrub in the revegetation area are used for collection of local seed provenances for use in farm replanting programs. Shelterbelts are



Location of Nambour, the town closest to Woombye

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formed of Gympie messmate and other local eucalypt species. The remnant vegetation represents a vegetation community that is threatened in the local area – riparian zones which provide timber corridors for wildlife. Vegetation surveys in the area have found 180 species of plants and approximately eight species of native mammals. These include feather-tailed gliders, gliders and brush-tailed possums, swamp wallabies, tawny-footed *Melomys*, echidnas, bandicoots and koalas.

The Triunia National Park is near the farm and is the only remaining habitat of the Triunia tree (a rare native shrubby rainforest tree). Two rare plant species occur on the farm and there is a small colony of grass trees, with *Macrozamia*, and giant ironwoods (*Choricarpia subargentea*) also present.

The farm is located in a high rainfall area (1800mm per year) and heavy downpours can occur in the December to May period.

The Staff

Mick employs one permanent staff member and has up to 12 casual staff, depending on the season. All staff receive Workplace Health and Safety training and the permanent employee has ChemCert accreditation. They are also trained in the aspects of quality management for packing and quality controls that are required under the Australian Persimmon Export Company procedures (Mick is an Associate member of this group).

The Environmental Management Program (EMP)

Mick doesn't separate out any enterprise in particular for environmental work, as he regards the entire farm as an environmental entity and manages across all parts of the farm in the same way.

Mick is working towards the development of a fully implemented EMS and plans to have his environmental performance externally audited against four key indicators (soil erosion and contamination, chemical use and disposal, water use and management, and biodiversity). His written environmental policy makes clear that he is striving to meet the requirements of the National Strategy for Ecologically Sustainable Development. Monitoring, analysis and review of results against local environmental conditions are all used to assess progress.

The highest priority issues being addressed on the farm are water and drainage management, erosion control and off-farm impacts, including spray drift and nutrient



Mick (at left) and John Muir (QDPI/Barung Landcare) inspect the 2001 persimmon crop.



Minimum impact from 20 cm of rain in 2 hours – erosion damage on Rivendell is minimised through the use of contours and vegetation filter strips.

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loss/transport. Issues that are being addressed over a longer-term basis are soil nutrient status, biodiversity management and chemical application. Mick feels that the key to good management is integrated planning.

The main drivers of change have been Mick's own beliefs and attitudes, with regulatory

pressures now reinforcing areas that had always been of concern to

Mick. *"The environmental issues were set from Day 1 – marketing issues will always change"* says Mick. However, Mick does plan to promote his environmental work on products in the future. Mick firmly believes that, in the long run, consumers must support farmers to address environmental issues. Whilst Mick is fairly confident in his own management, he is less confident that agriculture will be a viable option for him in the future because *"consumers at present only buy*

based on the cheapest price they can get". Mick feels that the prices paid for agricultural produce in no way reflect their costs – in terms of both environmental costs and production cost. He feels that there is little support for farmers. EMS is seen as one way of being able to validate claims for market support for sustainable farmers.



One of several revegetation plantings used to slow down water movement. They also act as a sediment and spray buffers.



Filter/buffer strips in operation – concrete flumes help direct water through buffer zones.



Recycling oysters! In an effort to boost calcium levels in the soil, Mick is recycling a waste product from another local industry.

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Monitoring

Records are kept in both paper and computer formats.

Many of the issues Mick monitors are addressed as part of his on-going QA programs. As financial matters are high on Mick's mind at present, he reviews income and expenditure daily.

ITEM	HOW OFTEN
Soil nutrition and organic matter – 150 mm soil cores	Annually
Leaf tissue analysis and plant nutrition	As required for each crop
Water quality in the packing shed	Tested annually
Vegetation, birds and mammals surveys	Done as a formal one-off survey in the past, now done by casual observation
Financial review	Twice a day
Water quality for use in spray rigs	As required, out of interest
Pest and predatory insects under IPM –crop walks and fruit fly traps	Fortnightly in June to Christmas period
Condition of Petrie Creek – 7 standard water quality tests (pH, dissolved O ₂ , nutrients, turbidity etc.)	Regularly under WaterWatch, results published in newsletter

Schedule of monitoring activities

Benefits and Costs

In the past, one of Mick's neighbours had been concerned about spray application on Mick's farm. By working closely with local Queensland Department of Primary Industries staff, Mick was able to demonstrate that his spray applications were being done in a responsible manner. He advises his neighbours of spray content and timing and does not spray at night near their boundaries. Ironically, the same neighbour later damaged a number of Mick's trees through inappropriate spray application. Again, QDPI staff were used to resolve this issue.

Mick believes that because he had established a good "track record" as a responsible farmer, it was easier to resolve the problem. Community relations have improved all round and Mick feels his responsible actions create a more positive industry image. Mick won the Sunshine Coast Environment Council Agriculture Award in 1998, an award that he is most proud of, as he feels that it represents both community recognition and understanding of what he is trying to achieve as a responsible farmer.

He has also gained improved market access over time, due to the quality of his produce and marketing liaisons with other growers. A final benefit has been the ease of gaining an irrigation licence, as he was able to clearly demonstrate his water use patterns.

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Other benefits of the management approach that Mick follows are the increase in native plants and animals on the farm, improved yields, reduced risks and greater confidence in his management approach.

Mick also states that without addressing water control he may well have now been facing a saline water management problem.

Mick has integrated the quality management requirements of his SQF 2000 accreditation with his approach to environmental management, streamlining operations wherever possible. This helps cut back on paper work. Often, the quality and environmental considerations go hand in hand anyway, so integrating the management approach is just sensible business practice.



One of the water storage/filter dams installed on Rivendell. Riparian vegetation (in the background) is being enhanced through strategic replanting schemes.

Mick feels that his environmental management has not really added any specific costs to his operations, as he made many changes as part of his quality management approach anyway. A large expenditure in infrastructure has occurred in netting the property (around \$112,000) and water control mounding, drain installation and filter area construction (at a cost of approximately \$110,000). Monitoring costs associated with quality assurance systems and production checks are around \$600 per year. Mick is currently negotiating with Queensland Department Natural Resources and Waterwatch for access to water quality monitoring facilities, where Mick supplies the samples to be included in monitoring regimes for the area.

The quality audits that Mick currently has cost approximately \$1000 per year. The development of the SQF 2000 paperwork for the farm cost \$3500 and Mick estimates he spent an equal amount of time as the contractor he employed to develop his SQF 2000 program.

Mick regards these costs as production related, however, and therefore not attributable to environmental management specifically. There has been a time cost though and as Mick says, “*You can’t go to the bank to borrow time*”!

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The Future

Mick suggests that a “Sustainability Australia” Department be set up to provide a one-stop shop for farmers and others who wish to develop and implement improved resource management. He believes that this Department could not only provide the benchmarks people should aim for, but could also assist with resource management audits and in the provision of information and training. This Department could also establish demonstration farms, where farmers could come to learn sustainable practices. As Mick has no family members who want to take over the farm, he is considering whether he should stay farming at this site or not. He thinks that he has around 20 years of farm management left in him, but believes that his farm is now worth more as real estate than as a working farm.

Mick would also like to see a greater degree of industry involvement and leadership in sustainable production practices. Assistance with goal setting and provision of information are critical areas required to encourage farmers to change.

Finally, Mick believes that the changes he has made make it easier for him to demonstrate his approach to management. He feels that such accountability will be crucial in the future.

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Author:
Genevieve Carruthers

Lyndarra Farms

Growing Vegetables at Forest Hill Environmentally Safe Production (ESP)

Kevin Niemeyer

Kevin Niemeyer purchased Lyndarra Farms, north of Forest Hill in Queensland, from his father in 1973, after helping him farm the site since 1961. The former dairy and piggery is now used for brassica, pumpkin, lucerne and grain production and relies on integrated pest management to reduce the number of chemical applications required per season. The IPM forms the cornerstone for the Environmentally Safe Production (ESP) group that Kevin belongs to.

Kevin decided that, as he “hated milking cows” and couldn’t get an increase in the milk quota, a change to cropping would provide a better farming lifestyle and income.

Kevin believes that without making these changes, he would not have been able to keep farming at the site. He is addressing soil fertility and water management in his farm plan and plans to improve native vegetation cover over time.



Location map of Forest Hill, Qld.

The Farm



The local weed control brigade!

Lyndarra Farm covers 48 ha and is located in the subtropical zone in the Lockyer Valley, Queensland. Farm soils range from creek bank loams through to heavy self-mulching clays. The farm is relatively flat, with slopes of less than 5%.

About 15 ha of the farm are devoted to intensive cropping of cabbages, broccoli (both winter crops) and pumpkins (the summer crop), with 30 ha used for soybeans, barley, wheat, corn, sorghum and lucerne. Approximately 2 ha are grazed by the neighbours’ cattle, to assist in weed control in a swampy area of the farm.

This area contains the only area of remnant vegetation on the farm, comprising local eucalypt species.

There are almost no native stands of trees surrounding the farm, with only isolated specimens present. Kevin is now working with the Lockyer Catchment Coordinating Committee to fence this area and keep the cattle out, to allow the area to revegetate without replanting. Keeping the cattle out will allow the natural seedbed to regenerate. Cattle will be reintroduced later to help with weed control. The native tree stands present mostly run along a wetland area and form a partial corridor through Kevin’s and the neighbouring properties. A small area of the creek bank will be linked with a small corridor of a neighbour’s property to achieve balloon vine

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control and to provide a wildlife corridor.

The remaining area of the farm is used for soy beans, wheat or barley. The annual land use depends a great deal on market demand for the various crops. The area of land put into fallow also depends on the conditions, but generally in the land used for grains, 15-20 ha are under fallow management at any one time.

All of Kevin's produce is grown for the domestic market, with 90% being placed before planting.

The Staff

Kevin employs between 8 to 10 contractors for brassica planting and harvest. These staff have VegeFresh (a local packing house) training and QA training. Keith Jackwitz, from VegeFresh at Gatton, has had a big role in developing the QA schemes that the ESP growers use on their farms. Kevin also employs an IPM consultant for crop monitoring.

The Environmental Management Program

Kevin was initially prompted to adopt IPM by the growing resistance problems appearing in diamond back moth control in the area in the 1980s and 90s. The lack of suitable control of this pest meant that the cabbages produced on the farm weren't meeting market specifications. Kevin says he felt embarrassed by the lack of quality in the product and felt he could achieve a higher quality product by trying something new. Around this time, Gatton Research Station began an IPM project and Kevin was one of the first to enlist.

Whilst Kevin doesn't have a written environmental policy, he is clear about what he is trying to achieve. He wants to be as clean and green as he possibly can, continually improving his farm management and the environment, whilst maintaining his farm as a viable operation. *"It's good to see the birds, frogs, ants and worms coming back – these had been missing in the days of high chemical use"*. While Kevin's three daughters do not plan on taking over the farm when Kevin retires, he hopes that the final price he is paid for the farm when he leaves will reflect the care he is taking of it.

Kevin rates chemical use as his highest priority management issue, with integrated pest management (IPM) not far behind. Despite using IPM for eight years now, Kevin still reckons he has a lot to learn about managing the beneficial insects on his farm.

Soil management is also a high rating issue, with water-use efficiency and delivery also being covered. Fuel use and efficiency are monitored to achieve savings where possible.



Sweet alyssum plants are used as nectar sources for beneficial insects throughout the brassica crops.

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Kevin monitors water levels in the bore using a simple tape and weight system.

Water use and delivery would move into a higher priority if Kevin had more money to change delivery systems. In the past, Kevin changed his tillage practices (from a mouldboard to a yeoman's plough). Kevin is now starting to concentrate more on the timing of changes that he makes to management, so that a more integrated approach is being followed.

The ESP group of four growers (each with a 25% share in the group) has developed its own production criteria. Each of the farmers in the group is a 'product captain', in charge of a particular line. Kevin is in charge of cabbage supply. If the 4 individual ESP growers can't meet demand, then the product captain can seek supplies from outside the group, but only from a supplier who is able to demonstrate that they meet the ESP production requirements.

The ESP group sends its crops to VegeFresh who in turn supplies to Woolworths and Coles Supermarkets. VegeFresh has its own QA program, based on SQF 2000. VegeFresh audits the ESP growers to ensure that they meet the QA requirements. The ESP group has also recently started directly selling produce at the Brisbane Farmers markets. Each of the farmers takes turns at promoting the work of the group direct to the public.

Monitoring

At present, all farm records are kept on paper, but Kevin is gradually moving records onto the computer. The IPM consultant that Kevin employs keeps records of insect numbers and compares these with insect activity records from nearby farms.

ITEM	HOW OFTEN
Pest pressure	Weekly bug checks are made, over season
Soil fertility and soil microbial action	Annual soil cores are taken
Water use	Meters are used to assess water use on a quarterly basis. Bore depth checks are made. Tensiometers are used to assess water availability
Weather conditions	Daily rainfall readings and wind reading by tractor ventometer
Fuel use	Tanker flow meter
Chemical use	Monitored through annual check on costs
Biodiversity	General counts are made, with species present noted, but no formal program of monitoring used.

Schedule of monitoring activities

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Benefits and Costs

Kevin believes that if he had not changed his chemical management he would not be able to grow brassicas on his farm now. He reports that he is getting higher yields (8-12% higher than the district average) and is using 50% less volume of chemicals than in the past. Overall, his production costs have dropped. In addition, because the time required for spraying has dropped substantially, Kevin can now spend more time in monitoring his crops and the environmental conditions on the farm. He feels that this allows him to manage better and provides him with greater peace of mind. He does acknowledge that this means more time spent in management.

More importantly for Kevin though, he feels that his family and staff are safer and the relations with the wider community have improved greatly. This was brought home when a neighbour complained about Kevin's spraying of corn. By working with Queensland Department of Primary Industries staff and Workplace Health and Safety staff, Kevin demonstrated to his neighbour that he was in fact applying chemicals safely and according to all legislative requirements.

Costs associated with making the changes on the farm have been fairly minimal. Kevin spent less than \$500 on IPM training and gaining Chemcert accreditation. Computer training also cost around \$500. Kevin employs an IPM consultant for 10 months of the year, for roughly \$5000. Soil and water monitoring costs are \$2-300 per year. A new boom spray rig was purchased, but Kevin says he "would have bought it anyway".

In terms of time, Kevin spends about 2 hours per week on paper work. He says that he has been developing his IPM approach for 8 years now and is still working on it! But he believes that the amount of information used in management doubles each year and so he is continually improving his knowledge.

Kevin says that the upside of these costs is that he is getting better information on which to make decisions – the better records, GST reporting, financial monitoring and use of computer are all contributing to help him manage better.

The Future

The ESP group plan on moving into more direct marketing and brand differentiation of their produce. Expansion of the direct selling through the Brisbane Farmers markets is seen as a valuable way to meet their customers directly and gain valuable feedback on their produce. Kevin believes that the changes he has made in environmental management will be an important part of a marketing 'edge'.

Kevin would also like to see supermarkets distinguishing environmental friendly produce and perhaps devoting more floor space to these products. *"Industry groups have an important role in this and should promote and facilitate cooperation between supply groups and marketing"*.

Kevin sees premiums as a major incentive for people to change their practices, but also believes that regulatory relief such as fast tracking of water licence applications, provision of good information from resource management and agricultural agencies and support from consultants as crucial items to help people change their management.



Pest insect species are monitored with sticky traps, pheromone traps and visual inspections.

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Author:
Genevieve Carruthers

The Gums

Making water work harder

Paul Ziebarth



Laidley is in the Lockyer Valley, Queensland

Paul Ziebarth, together with his father and brothers, owns the 30 ha family farm, The Gums, near Laidley in the south east of Queensland. He is a fifth generation farmer, with three generations on the current property. Paul's father purchased The Gums in 1965.

Paul's motivations to address environmental issues on the property are to conserve natural resources vital to the farm, to maintain market share and become more efficient in the way the business is managed. These changes were not imposed upon Paul but came from within as he considered the direction for the family business.

Paul considers himself to be a 'light green' farmer, seeking both good environmental outcomes while achieving market differentiation for his produce and maintaining a profitable business.



View over The Gums

The Farm

Within the family's farming history, there has been a transition from dairying to lucerne and now horticulture, which has meant an increase in cultivation. A variety of horticultural crops including carrots, tomatoes, watermelons and broccoli for processing and fresh markets is now grown on The Gums.

Diversification began when the property was purchased, with the development of a more intensive farming enterprise prompting concerns over unreliable water resources. Potato and onion crops were introduced then processing vegetable crops began in the 1970s. The move into fresh produce was triggered by problems with the processing market and the 1990s saw direct supplier status attained for Woolworth's. Tomatoes are presently the main crop, with a

range of other crops providing income.

Silver perch and red claw crayfish are being trialed as an alternative enterprise in the aquaculture development. Paul says that he began to think about increasing water use efficiency as a result of watching crayfish in his children's home aquarium. "I started to think



A recently planted tomato crop on The Gums

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about multiple uses for water and how we really weren't getting the greatest use from water used to irrigate vegetables. Using the water for more than one purpose just seemed logical".

Most vegetation on the property is along the creek lines. The species here are a mixture of riparian and rainforest trees and include blue gums, Moreton Bay ash, Callistemons, she-oaks, blackbutts, sandpaper figs and silky oaks.

Animals such as echidnas, possums, bandicoots, water dragons and carpet snakes are present, along with a variety of bird life. Platypus, although previously reported, have not been sighted in Laidley Creek for some years. Replanting and clearing of weeds along creek banks has achieved limited success, with drought conditions prevailing over the last decade causing some losses of planted trees. Paul plans to begin a new round of revegetation planting soon.

The farm has a number of houses close to the boundaries. Beef and dairy cattle also graze nearby paddocks. Thus spray control is very important on the farm.

Water from the farm drains to Narda Lagoon, which forms part of a recreational reserve in Laidley. Paul is very conscious of ensuring that water that leaves the farm is not adding to the nutrient load of the lagoon.

Paul and his wife Kim both hold degrees in horticulture from Gatton College, where Paul taught during the 1990s. Paul is currently enrolled in a Masters degree and is a member of numerous catchment, industry and research committees. He presently serves as President of Queensland Fruit and Vegetable Growers, a role that provides him with a broader industry perspective. *"Farmers need to get out and about more",* he says, *"take the opportunity to get off the farm and see what others are doing."*

Paul has completed a rural leadership course and won a Churchill Scholarship to England and Florida. He also took part in an industry-funded trip to Israel to examine integrated horticulture and aquaculture production methods.



The banks of Laidley Creek are overgrown, causing flooding on the farm in heavy rain. Revegetation with native species should help alleviate this problem.

The Staff

The business employs four permanent staff and up to 20 casual staff, depending on the season. As the business diversifies further, more staff may be employed.

All staff have appropriate training for chemical and fertiliser application and operating machinery. Paul has completed Future Profit and the Tomato Quality Project training, both courses providing valuable assistance in developing farm plans.

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The Environmental Management System (EMS)

The major issues of concern for Paul are the availability of a quality water source, soil compaction, fertility and health, and energy usage, which he believes will become an important issue in the future.

The environmental policy for The Gums states:

The principal aim is to produce the highest quality, safe food in a manner that does not harm the environment.

Paul is developing an environmental management system that will be certified against the ISO 14001 Standard. He also believes that integrating farm safety and quality assurance is important. *“The benefits of integrating QA, EMS and occupational health and safety are many. Audit costs should be cheaper, management will be more efficient and there are many complementary linkages and reporting mechanisms”,* says Paul. *“Using a systems management approach can only make all this simpler”.*

Some of the specific management changes on The Gums have included controlled traffic and permanent beds, compost making, the use of rock minerals, permanent underground trickle irrigation, managing farm wastes and improving integrated pest management strategies. Making these changes has involved some ten years of effort, particularly trials on the permanent beds.

The decline in available water and the condition of the soil were catalysts for the changes made to the management of The Gums. The move away from growing processing crops was partly triggered by concerns with soil compaction and management decisions have been greatly influenced by the need to conserve water and soil resources.

A reliable water supply has been one of the limiting factors on The Gums. Changes in water allocations over the years have altered the way water is extracted and led to a focus on water use efficiency. Paul uses an Enviroscan system and tensiometers to monitor soil water availability and is working with his neighbours to improve water use efficiency in the catchment. He sees such collaboration as benefiting both himself and his neighbours, because if his neighbours waste water it will affect Paul even if he manages water resources well.

The combined effects of drought and the debate about water resources meant Paul needed to assess how to improve water efficiency of cropping on the property. One of the methods employed is permanent underground trickle irrigation, which reduces losses to the air dramatically.

Paul had observed the decline in soil condition on the farm over time and is using knowledge gained from his post-graduate research into soil compaction to address

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this problem. Many of the changes being made on The Gums revolve around attempts to improve overall soil structure and friability. Paul is aiming to address soil nutrient status and the soil flora and fauna as part of his EMS. Paul has designed a new system to distribute 'compost tea' through his soils and has changed tractor and tillage equipment to avoid soil compaction. The use of controlled traffic and permanent beds has shown promising results in improving soil structure.

Tackling energy use is a personal challenge for Paul, driven by economic and academic interests. A switch to cleaner fuels is a longer-term goal for the business and will gradually come to occupy more management time as other issues are addressed. As the aquaculture enterprise comes on line, Paul plans to use methane generated on the farm from composting activities to fuel the pond water pumps.

Paul is working to establish an eco-label for all produce from the farm. The label will be used to differentiate all produce from The Gums in the market place. To do this, innovation is required. Paul is achieving this by using a systems approach which strives for the highest quality produce whilst keeping costs down.

Paul does not believe that market or consumer pressures are forcing changes to environmental management approaches on-farm. However, Paul wants to stay ahead of regulation and resource pressures and maintain a position in the marketplace; therefore he must constantly improve and adapt the way his farm and business operate.

Assistance for making management changes came from many sources. The family has been involved in farm planning and marketing workshops and Paul has completed business management training. The move to integrate horticulture with aquaculture was supported by a Farm Innovations Grant from AFFA.



An old Cobb & Co. road runs through The Gums and is protected from farm operations.

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Monitoring

Monitoring has been an important part of making improvements to environmental management on The Gums. Major reviews are conducted twice a year (timed around the summer and winter plantings). Financial reviews are conducted quarterly. Some of the operational issues are reviewed on a daily basis, particularly in the height of the production season.

ITEM	HOW OFTEN
Labour productivity	Hours labour versus productivity are reviewed weekly
Financial indicators (prices and costs)	Weekly to annually, depending on issue
Leaf analyses – sap, leaf tissues, Brix and dry matter	Every 3 weeks for tomatoes, other timing depends on crop
Soil fertility, CEC, pH and soil nutrients	15 cm cores are taken across the farm annually, sent for laboratory analysis
Water quality (<i>E. coli</i> counts)	Annually (Woolworth's requirement)
Water availability	Enviroscan and tensiometers provide weekly data
Energy use	Annual review
Crop scouting for integrated pest management program	Twice a week, by crop walks

Schedule of monitoring activities

Paul is considering conducting a life cycle analysis for the tomato production, to determine the full environmental impact of this crop.

Records are kept on farm using both paper and computer systems. Photographs are also used to record change, particularly for vegetation. Most of the farm workers fill out diaries and this data is incorporated into overall management decisions where appropriate, although Paul acknowledges that this does not happen as consistently as it should. One of the benefits of using the systems approach, according to Paul, is that “*there is a conscious decision to make all data collected in the business work to assist management*”.

Benefits and Costs

There are a number of benefits that are resulting from changed management on The Gums. There have been costs associated with making these changes, particularly for infrastructure. However, many of the costs have been associated so far with use of consultants for advice. The system is still being developed and applied and it will take some time before there can be an accurate idea of what the benefits might be in dollar terms.

Profits have not increased yet but with increasing yields, lower risks and an improved resource base, Paul believes that the farm is in a strong position to capture benefits. Some of these benefits are already apparent with approved supplier status, improved

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market access and greater confidence in how the property and business are being managed. Paul believes that in terms of market access, the net return from the business has increased by a factor of five. This is largely due to new crops, markets and enterprises (for example, the aquaculture venture).

Environmental benefits resulting from the management changes have been significant with improved pollution control, increased recycling, increased vegetation cover and improvements in the condition of the soil. In particular, Paul says that there have been major improvements in application of chemicals. Concerns neighbours had regarding spray drift have now largely been addressed.

A number of small grants have been used to address water use efficiency. The Moreton Drought Initiative provided funds to purchase the tensiometers and Paul shared the cost of the Enviroscan with his neighbour.

Funding for the development of the integrated horticulture/aquaculture enterprises has been received from an AFFA grant under the Farm Innovations Program. Paul believes that without the comprehensive farm plan he has developed, he would not have been successful in gaining this funding.

Finally, the Lockyer Catchment Centre supported the riparian revegetation work on a dollar-for-dollar basis. This Centre provided seedlings to the value of clearing and revegetation work done on the creek banks.

Costs have been incurred in the installation of ponds, piping and underground irrigation systems for water management and the construction of permanent beds. Training and consultants' costs (\$5000) were paid and there may be more staff employed in the future as the business diversifies further. There are ongoing monitoring (\$10,000/year) and quality audit (\$750/year) costs.

Paul also states that he has not yet commenced the major infrastructure improvements that he has planned. *"We have not launched into that yet. Over the next 10 years, I estimate that we will spend around \$700,000 on pond and marketing initiatives"*. Not all of these costs are related to environmental management, but it is difficult to separate out the environmental management from other costs at present.

Paul believes that without these changes and the incurred costs, he may well not have still been farming, having lost market share. He is very confident that the changes he has made (and has planned) have greatly assisted his overall approach to a management system and that they have provided both clarity of goals and the means to achieve them.

He also feels better as a farmer, more open to scrutiny, and able to demonstrate his claims of responsible environmental management.

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The Future

The ecolabel is now a registered brand and the development of marketing strategies to take advantage of the improved environmental management is a priority at present. Paul would have liked to complete things a lot faster and identifies the need for some central source of information and resources for EMS.

The family business is changing to become a commercial company. Paul believes that a company with an advisory board will bring discipline and purpose to the direction of the business. He believes that water management is now under control, but that the business now needs to concentrate on soil health, integrated pest management and energy use as the key issues for the future.

A key goal is to have 6.8 ha of the farm fully operational with the management improvements by late 2002. As his work and the business attract more publicity Paul is finding it easier to access help.

“In the future, consumers and markets will require that farmers be more accountable for their farm management practices” says Paul. The changes on The Gums have been made to position the business to take advantage of this increased accountability. Paul believes that through his EMS, he will be ready to meet this challenge. However, he does not expect that there will be price premiums for good managers. Rather, discounts are more likely to apply to less responsible farmers.

Clear direction from government regarding policy, support and environmental benchmarks will be important so that farmers know where to head. At the same time, the strong leadership role on environmental management shown by industry organisations, such as the Queensland Fruit and Vegetable Growers Association is also essential. Paul sees that such proactive, rather than reactive, leadership from both industry and Government will be crucial to encourage farmers to adopt EMS in the future.

Paul believes that improvements to biodiversity and to the condition of natural resources benefit the whole community and that therefore, the community should support farmers to achieve these outcomes. Such support would ideally come from preferential purchasing, but potentially could also arise from stewardship payments and/or community recognition and acclaim for good farm managers.

A centralised source of information on EMS would have been useful to Paul as he started to develop his management approach. While he could access some information from consultants, it would have been much easier and more efficient to have a ‘one-stop shop’ to use for EMS information.

Paul is enthusiastic about his future as a farmer and feels that his on-going efforts, matched by the continuous improvement feature of the EMS, will only strengthen his position in the market place.

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Red Braes

Leading light on the Liverpool Plains

Jim McDonald

Jim McDonald has long recognised environmental problems developing on the Liverpool Plains. In 1992 he became inaugural chairman of the Liverpool Plains Land Management Committee, which originated out of community concern for the uncoordinated drainage on the flood plains and the threat of rising saline water tables. As a result of the activities of this organisation and the 38 Landcare/Rivercare groups it incorporates, the Liverpool Plains has in eight years probably become one of the most highly studied and best understood catchments in NSW.

The Farm

Jim and his family grow sorghum, wheat and corn and run cattle on their 1419 ha property, Red Braes, near the southern end of the Liverpool Plains in northern NSW. Jim's grandfather established the farm in 1924.

They run 200 breeding cows on a mixture of improved and native pasture on the red brown and blackearths. Slope classes on the property range from 2 to 6. Warrah Creek runs through the farm and is regarded as a sensitive area.

Sorghum and wheat are increasing enterprises, while the wheat is declining. At the time of interview, Jim had 300 ha of sorghum, 100 ha of wheat and 100 ha of corn. Income on the farm comes predominantly from the cropping enterprises (80%), with cattle contributing the other 20%.

Native vegetation on farm consists of white cypress, plains grass and white box woodland communities. A similar composition of species is found surrounding the farm.

There are about 290 ha of native grasses, remnant vegetation and shelter belts on Red Braes. Approximately 80 ha have been set aside to maintain or increase biodiversity and are managed under a conservation agreement with the Department of Land and Water Conservation (DLWC). Fencing for this area was funded by a grant from the DLWC. A further 10 ha have been set aside for an agroforestry enterprise.

Jim feels that while his farming has some impact on the catchment (any change from the natural state is an impact) his farming operations are at least equal or better than the current 'best practice' level for dryland cropping operations in the area. Rising water tables and flooding impacts from the catchment affect Jim's operations.

Jim has seen a number of changes in environmental conditions on the farm since he took over its management. Ground cover levels have increased in all areas of farm enterprises and native vegetation has begun to regenerate. Koalas have also recently been observed in the area, for the first time. However, Jim observed that soil nutrients have

Authors:
Belinda Walker, Gavin Tinning
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Jim's farm is at Quirindi, on the Liverpool Plains of NSW.



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been declining over time and he is working to address this issue.

The Family

Jim has been farming for over 25 years. He has an Associate Diploma in Farm Management from Orange Agricultural College, while his wife Katrina has an Agricultural Economics degree and a Rural Science degree. Jim is the independent Chair of the Namoi Catchment Management Board, the Namoi Groundwater Management Committee, the Namoi Regulated River Management Board and the Namoi Unregulated River Management Board.

The Environmental Management System (EMS)

While there was no particular crisis that forced Jim to change his practices, he could see that his terms of trade were slowly declining. *“Doing the EMS was an opportunity to turn that around”*, he says. Jim also believes that an EMS helps him to distinguish his product in the market place. The increasing use of fertiliser over time, flood events and soil erosion were other factors stimulating Jim to adopt an EMS.

The four main goals for Jim are to :

- have a safe and healthy farm
- have good financial management
- supply safe products
- improve environmental conditions.

Jim has built these factors into a written environmental policy for Red Braes.

The highest priority issues for Jim currently are:

- chemical application and use efficiency
- safe chemical storage
- occupational health and safety
- meeting all of his legal responsibilities.

Product safety, financial and environmental performance, the use of internal audits to check progress and communication are also issues dealt with by the EMS. As time goes on and the EMS is further developed, the priority issues will change, to reflect improvements made in managing these issues.

Jim has gradually changed his farming practices over from conventional tillage, to no till. *“We haven’t cultivated for nearly three years.”* He now direct drills all crops on both the black and the red soils and all his pastures.

Fertiliser is only applied at sowing. By avoiding pre-application, Jim hopes to reduce the chance of fertiliser leaching into the underground water table, or washing away in floods. He prepares fertiliser budgets for expected yields and uses mainly prescription fertilisers. Climate is also a factor for determining inputs and on a negative SOI outlook



Piezometers are in place to keep track of water tables and encroaching salinity.

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he has reduced sowing rates and fertiliser and even opted not to sow a crop at all. The decision proved to be the right one and he avoided losing money.

Jim ‘response crops’ (that is, he plants on a set of predetermined responses rather than according to rigid rotations) to try to reduce water table levels. Because of this, he has become far more particular about the types of chemicals he uses. *“We don’t use as many residuals as we used to. We can’t afford the lost opportunity of a future crop because of a residual chemical in the soil.”*

Fallowing is no longer necessary, partly because the soil is in better condition, with no compaction layer, so it stores more moisture.

On the grazing country, cattle have long ago replaced sheep. This was not done for environmental reasons at the time, but Jim can now see the environmental benefits. Cattle have less impact on ground cover than sheep. Larger mobs are being rotationally grazed, instead of set stocked. Jim tries to leave the cattle in one paddock for 20-30 days, then rest it for at least 50 days.

“We try to keep good grass in front of the cattle. Paddocks need good ground cover as well as other management considerations. Some paddocks we preferentially graze in certain months of the year to decrease the weed pressure and seed set and other paddocks are spelled to provide an opportunity for native grass seed set.”

Much of Jim’s information has been sourced through the Liverpool Plains Land Management Committee and the contacts with researchers that he has made through the committee.

Monitoring

Jim uses a palm pilot to collect data in the paddocks, then downloads this information onto the office computer. He also uses maps, photographs and other paper records. An annual review is done by Katrina and an external EMS audit is also conducted annually.

ITEM	HOW OFTEN
Weather conditions	Daily
Ground water depth and salinity	Quarterly
Soil nutrients	Samples are taken when required (always pre planting or fertiliser application)
Soil Moisture	Prior to planting decisions
Communications	Communications register reviewed as needed
Groundcover levels	When stock are moved
Yields	Annual review of key performance indicators
Chemicals applied	Records kept as chemical used
Biodiversity audit	Annually
Legal compliance	Annually

Schedule of monitoring activities



Tree numbers on the property are increasing, as young trees are fenced off to allow them to become established.

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Jim is also a member of the “AgVance” group, 13 producers who together own 70,000 ha of the Liverpool Plains. They contribute \$2.50/ha (of their cropping land) to a fund; this enables them to employ their own agronomist. (For Jim that is about \$5,500/year). Their agronomist visits each farm about once a week to do whatever testing is required and then interprets results. He gives technical advice and helps with planning. The group meets monthly to learn from each other.

The group does its own research. For example they have started spraying test strips of stubble with molasses, to see if this increases the number of soil bacteria present and thus the rate of stubble breakdown. The effect of soil fauna on the overall biological health of the soil is of particular interest to the group.

An EMS audit program is now in place with regular internal and external audits. Data collected through the various monitoring that Jim carries out is built into routine decision making.

Benefits and Costs

Jim attributes a definite increase in yield to the adoption of zero-till farming. *“Over the years I would say no till has meant an increase in average yield of 1.5 tonnes/ha. It’s a lot of grain. In terms of dollars (say for sorghum @ \$130/tonne) that’s about \$190/ha due to zero till.*

Adoption of no till has also meant a substantial saving in fuel and wear and tear on machinery. The fuel bill is now only about 10% of what it used to be when conventional tillage methods were used!

Better groundcover and feed management have increased our calving rates by 3-4% and we produce better yearlings, so you’d probably say another \$5-10/ha overall benefit from cattle.” Also, he had not foreseen the degree of reduction in fuel costs and the decrease in maintenance costs on tractors.

The improved record keeping involved in setting up an EMS has meant that it is far easier *“to track and understand our financials – to know what contributes what to the gross margin and track the benefits of changing a particular practice.”* Jim also feels that the discipline of an EMS is a benefit. *“There is more focus on detail. When you’ve got your systems in place, it is certainly a lot easier to deal with things.”*



Soybeans (silage) and maize growing on the fertile black soil plains

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The Future

Jim believes that “market access will continue to get tighter and tighter, depending on your ‘environmental credentials’”. He has achieved ISO 14001 certification for his business and believes that setting up an environmental management system helped improve his management. *“Good discipline and more focus on detail. When you’ve got good systems in place, it is certainly a lot easier to deal with things.”*

Jim does not yet get any improved market access through recognition of his 'environmental credentials', but is hopeful that this will occur in the future. Jim has developed a handout sheet that he gives to customers purchasing his cattle (see below). This sheet provides information about what the EMS is trying to achieve and may assist Jim in gaining preferred supplier status, although it is very early days yet.

The "AgVance" group is negotiating with a large local end user to supply them with grain. The end user has expressed some interest, based on quality assurance, and the group is hopeful that they may get preferred supplier status and some sort of guaranteed price that will take the humps and troughs out of their income from grain, even if they don't get a premium.

For the future of their enterprise and agriculture generally Jim has two principles that he sees as the focus for the future:

- to be responsive to the natural events that affect his farm and catchment; and
- to try to increase the perennial nature of his farm, so that as much of the ground as possible has something growing in it for as long as possible.

He believes the big issues in the future will be:

- water re-charge and water balance;
- increasing biodiversity; and
- soil health – both chemical and biological status.

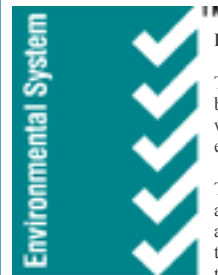
He is fairly confident in the future of his industry "because people can't do without bread!"



Jim and Katrina McDonald and children, Emma and James

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Dear Buyer,

This consignment of beef has come from what we believe to be the first 'grain and beef' farm in the world to be certified under ISO 14001:1996 for environmental management.

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We started with a simple management system based on implementing Cattlecare and have developed our Environmental Management System (EMS) to include all of our environmental risks and the necessary actions to reduce them.

Our everyday farm activities incorporate environmentally responsible practices and we have been third party audited to ensure that we are achieving our specified aims.

For more information please contact:
Jim McDonald, 02 6746 1091, 0429 461091,
marianker@bigpond.com

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Andamooka lies just
near Spring Ridge on the
Liverpool Plains of NSW.

Andamooka

The challenge of continual improvement

Peter Jones

Andamooka is situated near the village of Spring Ridge on the Liverpool Plains in northern NSW. Historically the Liverpool Plains were covered in Plains grass and were grazed by sheep. More recently, with the advent of more powerful machinery capable of working the heavy black clays, the area has progressively been converted to cropping and is now regarded as one of the best farming areas in NSW.

However, since the 1980s problems have begun to emerge with erosion and salinity. Huge quantities of water flow across the Liverpool Plains during floods and some say that the Plains grass used to hold the water up, so that it travelled more slowly. Now that the native vegetation has largely been cleared, less water is being used and the greater, faster flows result in more erosion.

When flooding occurs, water flows across Andamooka and into the Coomoo Coomoo Creek, which forms its eastern boundary. Flows are now so great that the banks of the Creek are collapsing into the creek during floods, eating away at Andamooka's valuable farming land. This damage was already considerable when the Jones family bought the 924 ha property in 1992.



Picture shows the junction of two erosion gullies with Coomoo Coomoo Creek, where the banks are collapsing inwards.

The Farm

Andamooka was originally a sheep and cattle farm, with grazing on Plains grass pastures. Peter Jones runs the farm on his own, but does make some use of contractors for various tasks.

About 800 ha of Andamooka are used in a summer/winter cropping rotation. Sorghum is the major crop grown, with wheat, maize, barley, sunflowers, and legume crops also grown. Grain from the farm is sent to both domestic and international markets. Peter doesn't follow a set rotation pattern as he tries to make the best use of soil moisture when it is available.

Peter has set aside 56 ha as an agroforestry block and there are approximately 2 ha of remnant pine vegetation. Native vegetation stands surrounding the farm are comprised of ironbarks, yellow box and belah she-oaks.

Soils on Andamooka are mostly black self-mulching soils and there is one paddock (80 ha) of almost pure sand. It is this sandy soil that is being used for the agroforestry venture. The farm is mostly flat with a slight eastern fall.

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The village of Spring Ridge lies on one side of Andamooka and the Spring Ridge State Forest is on the southeastern boundary of Peter's farm.

The Environmental Management System (EMS)

Like another case study participant, Jim McDonald, Peter opted to work towards ISO 14001 certification, as a means of planning his management changes, measuring change and thus recording his progress. Certification was achieved in August 2001, following a busy few months of audits and changes to the management system. He believes that imposing this sort of structured management system, with a time frame for proposed changes, is necessary if he is to ever get things done. *"The idea is to take all the emotion out of decision making – to make decisions on quantifiable grounds and financial grounds."*

Peter's environmental policy states, in part:

"The goal of Andamooka is to achieve a balance between financial stability and a sustainable presence of the land, whilst minimising potential environmental impacts associated with our activities".

Key issues tackled on Andamooka are pollution prevention, biodiversity management, waste minimisation, use of appropriate indicators, communication, and ensuring that all legislative and industry code of practice requirements are addressed.

From the outset, Peter has put enormous effort into trying to control erosion. He says that 30-40% of his decision-making is based on erosion control and the rest is economic. *"You can't grow crops just for their environmental benefit, otherwise we would all just grow kikuyu."* For example, he tends to grow more sorghum than sunflowers, because sorghum is bulkier, leaves more ground cover and will slow the water down more and bind the soil better, in the event of a flood.

He has also narrowed the strips between farmed and fallowed country. *"The idea was to always have flood water hitting the crops within 140 m of a fallow area – not to have big areas for the water to build up speed – to try to slow the water down and spread it out"*. He is not yet sure whether this practice is having an effect.

Peter is open-minded about methods of tackling erosion. *"The goal stays the same – the method of achieving those goals changes all the time."* Some farmers in his area have actually started farming down the slope, rather than across the slope. They reason that if you hold up too much water by farming across the slope, when it eventually



Peter has started a system of photographing his erosion gullies, so that over time he will know if he is reversing the erosion damage.

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breaks down slope, it causes more damage. By farming down slope they believe that the water is being split up into smaller channels, so it does not build up the volume to do as much damage. Peter is reserving his judgement, but is prepared to change if evidence builds up to support this theory.

In collaboration with his neighbours, Peter is also working towards improving the riparian zone. They plan to revegetate creek banks and use stock selectively to assist with weed control. The group is negotiating for 'Super Solutions' funding to assist with this work.

Peter believes that his EMS is one of the best ways for farmers to adopt catchment-wide environmental goals. Having the Liverpool Plains Catchment Management Plan has been very useful, as it provides a clear indication of the environmental expectations for the whole area within which Peter can develop his EMS.

Like most others on the plains, Peter has now given up the practice of long fallowing, since the problem is now more likely to be too much soil moisture, rather than too little. *"We do a lot of double cropping, where one crop follows another crop within two months of harvest. So you'll follow sorghum with a winter crop, if you've got enough moisture, but not*

the other way around – usually a legume like faba beans or chick peas." There can also be disease problems arising from following grasses with grasses, so Peter tries to avoid such rotations where possible.

Fertiliser use is also much more targeted. *"We are trying to get to a situation where moisture limits our yields and nothing else."* Peter is one of 13 farmers in a local farming group – 'AgVance'. Prior to planting each crop, soil tests are done and the agronomist employed by the group recommends specific fertiliser requirements, which are then formulated according to the needs of the crop to be grown.

Over the past few years, Peter has converted all the cropping country to 'tram lining', i.e. all machinery runs on the same tracks and there is no traffic on the areas where the crops are grown.

Peter has not yet seen evidence of salinity problems on his property, but farmers in his area have been warned that this is an emerging threat for the Liverpool Plains. Partly because of this threat, Peter has agreed to the use of 70 ha of his sandy country for a forestry trial, run by State Forests. Piezometers are to be set up from the top of the hill to the bottom of the plain at the start of the trial and these will be monitored monthly to see if the trees are making any impact on water/salinity levels. By using piezometers prior to establishing the agroforestry plot, Peter hopes to be able to track changes in the watertable over time.



Tram lining of crops means that all traffic is confined to a narrow strip of soil and the area cropped does not become compacted.

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Monitoring

An EMS audit program is now in place with regular internal audits and external audits planned for every 6 to 9 months. Data collected through the various monitoring programs is built into all routine decision making, providing some flexibility for the seasonal variations in the level of farm activities.

As Peter is a single operator, he needs to have simple methods and formats that allow him to collect data that he will actually be able to use. Some sampling is conducted by consultant agronomists.

ITEM	HOW OFTEN
Weather conditions	Daily
Soil and ground water salinity - sampling and piezometers	Measured by State Forests under joint venture
Soil nutrients and soil biota	Samples are taken when required (always at pre planting or before fertiliser application) for nutrients
Erosion gullies	Photos after storm events
Soil Moisture	Prior to planting decisions
Fuel store condition	6-monthly
Communications	Communications register reviewed as needed
Quantity and condition of stored chemicals	Every 2 months
Grain stores	Monthly when in use
Chemicals applied	Records kept as chemical is used
Waste oil quantity	Quarterly
Yields	Annual review of key performance indicators
Integrated pest management sampling	Crop scouting as crop cycle demands
Legal compliance	Annually

Schedule of monitoring activities

Peter conducts a pre-planting review using the monitoring data. He has found that photographing erosion gullies is a simple but effective way of monitoring changes over time.

Benefits and Costs

While it is still very early on in the implementation of his EMS, Peter feels he can already pinpoint a number of areas of benefit. He acknowledges that in many cases these are currently subjective, but feels that he will be able to measure them in the future. Overall, he believes that he is 30% more efficient than conventional farmers are in his overall management.

Peter has already noticed improvement in the texture of the soil and estimates that average yields have increased by about 0.5 tonne/ha. He says that when agronomists visit his farm, they also remark on the softness and friability of the soil.

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An unexpected benefit has been the saving in chemical, due to reduced overlap and not treating the wheel tracks. This has meant a saving of 10-20% on chemical costs. Peter comments that it is also easier on the neck, since you are not looking behind all the time!

The increase in yield due to his farming practices and his savings on chemicals mean Peter is well ahead financially, but he is still uncomfortable having to justify the odd weed in his crop (missed due to banding of chemicals) to traditional farmers. Peter also has observed that in a dry time, his crops hang on better than those on conventionally farmed country.

Peter estimates that he has spent around \$4000 on infrastructure and capital equipment in developing his EMS. He also purchased a computer program 'Farm tracker' to help with record keeping.



The occasional weed is a small price to pay for improved environmental outcomes.

Although acknowledging that the external audit of the ISO system is expensive (probably \$5,000 initially, then about \$1,500 per annum), Peter feels that this is money well spent if it forces him to actually achieve what he had documented in his environmental management plan. *"If you weren't audited, would you actually get around to making the changes?"* Peter finds that the audit process makes him keep working towards his goals rather than putting them off for another day.

Peter acknowledges the assistance of NSW Agriculture in setting up his EMS and achieving certification. He feels that without some sort of assistance, it is not realistic for small-scale farmers to attempt something like ISO certification. *"But there are economies of scale – if there were say 13 farmers on the Plains doing what Jim and I are doing, then the first thing we would do is employ an environmental officer to actually come around and do this kind of stuff. There's a bit of a critical mass that needs to be involved to get started. That's why I would say that small operators like me are just not in a position to employ people to do this and do need the outside help to do it."*

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The Future

Peter believes that farmers' inputs to agriculture are too high. In particular, he does not believe the high level of chemical use that is currently the norm is sustainable. *"Being so reliant on chemicals with no-till farming is the biggest cloud on the horizon, for sure. I've already selected for "difficult to kill" weeds – the only weeds that grow well here are the ones I can't kill with Roundup."* Chemical resistance in plants is clearly becoming an increasingly important problem on the Plains.

Peter also believes that chemical contamination of food products, including grain will become an even bigger issue than it is now.

Peter sees the consumer as the main driver of change. The consumer needs to start demanding "ISO food" in the way that they now demand organic food. At the moment, *"people don't approach the supermarket manager and say, "Why haven't you got any ISO food?" It all comes back to consumers recognising that this ISO is an attempt to farm in a sustainable way and to create a demand for it. Most consumers recognise the Heart Foundation's red tick. We need a recognised and understood symbol like that (a green tick?) and a campaign to promote it."*

Peter is not confident that he has all the answers to the control of erosion on his property. The excessive clearing in the past in the whole Liverpool Plains area and previous agricultural practices have left a legacy that no one individual can control. The practices in the whole catchment will probably need to change if erosion and rising water tables are to be controlled.

However, Peter is always searching for answers. He is confident that his farming methods can still become more efficient than they are today. Through closer monitoring of changes on his property in the next 5-10 years, he believes that he will be able to judge whether he is winning the battle against erosion.

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Authors:
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Oakville Pastoral Company
is located on the outskirts of
Narrabri, NSW.

Oakville Pastoral Company

Leading the cotton industry by example

Mike Logan and Rachel Holloway

Oakville Pastoral Company is a family farm owned by Mike and Robyn Logan, situated on the outskirts of Narrabri in northern NSW.

It was purchased as a sheep property by Mike Logan's grandfather in the 1920s, but gradually converted to dryland farming. Cotton and irrigation were first introduced in 1964.

The Farm

The 810 ha farm has 470 ha of irrigated cotton fields with the remainder of the area used for dryland production. There are small patches of remnant vegetation on the farm, composed mostly of belah, casuarina, and bumble box eucalypts. Native grasslands form the natural understorey. Much of the original native vegetation had been cleared from the farm when Mike took over management.

Farm soils range from red loams through to black cracking clays on the flats. The majority of the farm is flat, with some low rises. No free flowing creeks are present on the farm, but there are some drainage lines. Irrigation dams and channels have been added or improved since Mike started to manage the property.

Approximately, 90% of the income generated from the farm comes from cotton, with the remainder from sorghum and wheat production. Cattle had been run on the property until about four years ago, but now have been taken out of the production system, due to past low returns.

The Staff

Mike Logan employed Rachel Holloway as the environmental officer on Oakville around four years ago. Both she and Mike have environmental systems auditors' training and Rachel holds a Bachelor of Applied Science in Systems Agriculture.

All farm managers have undertaken the Cotton Best Management Practices training program. Farm staff also receive backhoe and forklift training (if required), farm chemical user training and occupational health and safety training.

Mike was on the Board of Cotton Australia and Chairman of the Best Management Practice Committee. He and Rachel helped write the BMP Manual that the cotton industry has now adopted. Mike is also a current Director of Land and Water Australia.



The entrance to Oakville Pastoral Company

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The Environmental Management System (EMS)

In the 1990s, Mike became more interested in environmental aspects of farming. Three main reasons promoted the adoption of improved environmental management on Oakville. The first was the ability to distinguish the products from the farm in the marketplace, on the basis of sound environmental management. The second was a desire to demonstrate those responsible practices. The third was to have continued access to resources, as a result of the demonstration of sound practices.

“I realised that you could have environment AND profit; it didn’t have to be environment OR profit” says Mike. He began working towards certification using the ISO 14001 standard in the late 1990s. He subsequently became the first farmer in the world to have his management system certified under that scheme. Mike says that ISO 14001 is a relatively simple process. *“People should get some EMS training for themselves, visit a farm that has an EMS in operation and then go and do it on their own farm”*.

Oakville is very close to “7000 sensitive noses” living in Narrabri and Mike wanted to do the right thing by the community and to set a good example. But he also believed he could get a marketing advantage out of growing “environmental cotton.”

A separate company, “Southern Star Cotton” (a partnership between Mike and John McVeigh), was set up to process and sell high-quality, environmental cotton to Australian clothing manufacturers. The product was promoted as being environmentally friendly, originating from the first cotton farm in Australia to have ISO 14001 certification. Mike found that this promotion worked well with the manufacturers - *“it got us through the door, but it wasn’t sustainable at a consumer level. We don’t get a premium for our product”*.

The main environmental issues for the farm are to:

- ensure compliance with all licensing requirements;
- minimise and manage surface and groundwater pollution;
- minimise and manage agricultural soil impacts;
- optimise water use;
- minimise spray drift impacts;
- improve on-site waste disposal operations; and
- minimise chemical packaging/waste generation and maximise use of re-cycled containers.

These issues have been determined and prioritised through a formal risk assessment process and are derived from a longer list of activities on the farm. Regulatory pressure and licence requirements have been major factors that determined the issues addressed under the EMS.

One of the most controversial issues for the cotton industry in the past has been the spray drift. Part of the answer to this on Oakville has been the reduction in the use of chemicals by controlling cotton pests through other means. Mike now grows Ingard



Mike Logan and Rachel Holloway inspect cotton grown on Oakville.

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cotton (which is genetically modified to be pest resistant) and this has reduced the number of sprays required per season from about twelve to one or two. Sprays are now predominantly applied by ground rig rather than by aerial application.



One of the policies on Oakville is to plant one kilometre of trees per year.

All chemical storage and wash down areas are bunded and connected to sumps. Sumps hold waters for evaporation. “Person-friendly” chemical transfer systems and trucks are now also used.

Another means of reducing chemical use is the use of integrated pest management (IPM), which involves encouraging predator insects into the crop and/or increasing biodiversity, so that the cotton is not the only target. Replacing trees and growing a variety of crops, rather than just cotton, helps in this strategy.

In an effort to boost the vegetation on-farm, Mike has entered into farm forestry trials with both NSW Forestry and Greening Australia. “We are trying to establish tree corridors along the farm, but so far, haven’t attempted to link them to other corridors in the local area” stated Mike. Rachel also pointed out that there is little native vegetation surrounding the farm, so linking corridors would be difficult at present.

Soil management is being addressed under the EMS. Reduced tillage of fields, use of tram tracks and GPS technology potentially in the future, assist in reducing soil damage resulting from tillage practices.

Another management aim on Oakville is to retain all tailwaters on the farm. Although full control of tailwater is difficult in an area that has heavy downpours from storm fronts in summer, control of tailwater is seen as critical in preventing harm to local waterways.

Communication with neighbours has increased, although Mike was somewhat ahead of his time in the cotton industry in this regard. It has been his policy for a number of years to visit neighbours at the start of each season, to let them know what he was doing, what sprays he would be using and when. Since the controversy over cattle becoming contaminated by chemical spray drift

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Oakville
cotton field

from neighbouring farms, much of the cotton industry has now adopted the same practice, but Mike was one of the first to do this. Mike believes that the cotton industry BMP work means that the industry is now looking much more sustainable in the future.

Monitoring

Mike uses a number of measurements to keep track of what is happening on his farm. More stringent requirements for monitoring, arising from changing requirements imposed by the NSW EPA and the National Registration Authority (for chemicals), have been addressed through the monitoring program on Oakville.

ITEM	HOW OFTEN
Soil fertility and nutrition	Core samples are taken annually for each field
Crop moisture	Taken daily, prior to any irrigation application
Crop nutrients (N)	Petiole tests, with soil tests as a follow up.
Tail water tests for pesticide residues	Laboratory analysis done annually
Water use and efficiency	Neutron probe at 3 sites, 2-3 times per week
Potential for deep drainage	"C" probe samples every 15 minutes, computer linked
Insect populations	Counts done on crop walks every 2 days in season
Correct chemical storage	Annual stocktake and review of stores
Spray drift potential	Wind speed and direction, temperature taken whenever spray applied.

Schedule of monitoring activities

Tailwaters are monitored for chemicals; soil fertility is monitored from both soil and leaf samples. The amount of chemical used at each application is checked against acreage treated, to ensure that the application rates/concentrations used were correct.

Soil moisture is monitored on a continuous basis, at three sites 2-3 times per week with a neutron probe and in one location every 15 minutes, using a 'C' probe. This ensures that the application of irrigation water can be matched precisely to the requirements of the crop, thus increasing water-use efficiency.

A monthly meeting is held to discuss management issues. Pre- and post-season meetings are also held and there is an annual environmental review and audit.

Records are kept on a mixture of paper and computer formats. Field records are entered onto computer databases. Data are also used in computer modelling programs to predict insect pest pressure. Workcover directories are used, as are chemical companies' CDs for accessing information needed for management. Various accounting programs are also used on Oakville.

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Benefits and Costs

Mike believes that there will be marketing benefits to his approach in the future, but he is not optimistic about receiving a premium at present. For the moment, he sees other benefits – an improved resource base, better soil and crop health, less time required to fix problems, lower risks and liabilities and greater peace of mind.

For example, he now manages and share-farms three other properties. Mike believes that the owners of these properties have confidence in his management due to his adoption of EMS.

Rachel Holloway works as a consultant to a number of farms now and so defrays her salary costs. This work stimulates interest and confidence in the management processes employed on Oakville.

The savings in chemical costs have been considerable, with applications dropping from an average of 12 applications a season down to two or less. Water-use efficiency work also results in savings. Mike says that he has not directly worked out these savings as yet, but can give a rough estimate that chemical costs alone have dropped by nearly \$195, 000 per year. The increasing biodiversity arising from reduced spray applications and revegetation work is a spin-off benefit.

Mike also believes that by using the ISO 14001 process, he also is addressing quality and occupational health and safety issues. *“All these areas of management are combined under our EMS,”* he says.

Of course, there have been costs in implementing the EMS. The savings in chemicals have to be offset by payment of crop scouts and other IPM measures.

Mike paid a consultant approximately \$20,000 to develop the initial EMS. Both Mike and Rachel did environmental auditor training. Other staff training costs around \$500 – \$600 for particular staff members each year. However, Mike says that he went about the process of developing his EMS backwards. *“We should have done the training first and then maybe used a consultant”* he says.

There were also infrastructure costs initially. Mike estimates that he spent \$20-30,000 on sheds, fire fighting and safety equipment. *“These costs were mostly early work that needed to be done anyway”.*

Finally, audit costs are approximately \$4000 per year. Mike is hoping to extend the time between audits to every 12 months and so reduce the overall auditing costs.

Mike also received assistance from the former Federal Department of Primary Industries and Energy (now AFFA) Agribusiness Program to fund the market research conducted into the demand for environmentally friendly cotton.

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The Future

Mike has found that many of the local cotton people reacted against the changes he was making. He found that the best way to change this was to invite them onto the farm. *“Once they’ve been to the farm and seen that it’s actually a normal cotton farm not unlike theirs - we’ve built a nice shed for the chemicals and we’ve trained a few people and written a bit of stuff down, they think, “Oh, that’s not so bad,” and they get a lot less offended. All the ones that have been here really calm down.”*

Mike has maintained an open door policy and estimates that he would have had about 200 bus tours through the place in the last four years, *“everyone from mums and dads to politicians, from Sweden to Broken Hill.”*

Mike believes that in the future, governments will legislate for change and he will be in a much better position than most other farmers. *“Governments will force farmers to produce according to environmental standards. And those who already do this (by using an EMS) will really meet those requirements easily”.*

Mike would like to see some government recognition for people like himself, some sort of reward that would motivate others to follow. Government *“just declares that now everybody has to catch up to us”*, he says. *“They would soon catch up to us if we had something that they didn’t! Government needs to be really creative in making incentives and rewards.”* For example, if farmers with a certified farm had access to resources that other farmers didn’t, Mike believes that this would quickly change behaviour. He uses the example of Helix, a widely used chemical in the cotton industry. *“If I had access to that, because of my EMS and others didn’t, there would be much quicker adoption of EMS!”*

Mike thinks that biodiversity will become more and more of an issue for agriculture in the future. *“We will get into a more landscape level of thinking. We will be asking how can we change our farm to fit into the broader landscape, . . . how can we regenerate the activities in the soil? How do we mimic what was there in nature? What sort of ecosystem services are we providing?”*

Mike is confident in the future of the cotton industry and proud of its recent achievements. *“Five years ago the cotton industry were the environmental villains; vandals. In five years we have turned it around.”*



Different crops such as sorghum are grown on Oakville in rotation with cotton, partly as a means of increasing biodiversity.

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Author:
Genevieve Carruthers



Main Camp is located near Rappville, on the Far North Coast of NSW.



Front gate entrance to Main Camp



One of the fields of *Melaleuca alternifolia*, from which tea tree oil is extracted

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Main Camp Holding Pty. Ltd.

We grow a natural product—our methods must be sustainable
Ross Garsden and Dennis Williams

Main Camp Holdings Pty. Ltd. is one of the largest producers of tea tree (*Melaleuca alternifolia*) oil in Australia, with 200 tonnes of oil produced each year.

The 4,400 ha farm is located on the Far North Coast of NSW, near Rappville. Formerly a grazing property (established in 1888), tea tree establishment began in the mid -1980s. Some previous bush harvest of tea tree had occurred by the stock hands who took the harvest proceeds as part-payment of their wages.

The current owners took over management of the farm in 1999 and have dramatically altered the way environmental management is regarded on the farm. The environmental manager, Ross Garsden and the plantation manager, Dennis Williams, are confident that the Main Camp farm is having no adverse effect on the surrounding subcatchment area. They believe that the future of agriculture is in sustainable practices, recognising that there are increasingly scarce resources available for farming. They see the operation of an EMS as a way to both conserve resources and keep abreast of increasingly stringent regulations controlling farming. “The EMS and subsequent management practices have engendered a true sense of pride in the workplace”.

The farm had trialed organic practices for part of the tea tree plantation but this was abandoned, as the returns gained for products did not justify the expenses required to maintain these production practices. An EMS is seen as a way of integrating business, quality and environmental management through the one approach.

The Farm

Tea tree, *Melaleuca alternifolia*, is grown on 1553 ha of Main Camp, with a further 7 ha devoted to production of lemon-scented tea tree, *Leptospermum petersonii*. Approximately 600 ha are used for grazing Brahman and Brahman cross cattle. Tea tree mulch sales form a minor component of the business.

Native vegetation covers 2000 ha of the farm, which includes 25 km of riparian vegetation. Revegetation of riparian areas is occurring through both natural means and through replanting and the riparian vegetation forms corridors linking with those on surrounding farms.

Two major water storages (each approximately 1000 megalitres capacity), several creeks and four lagoons, combined with irrigation channels provide significant water-bird habitat on Main Camp.

Several flora and fauna surveys have been conducted on Main Camp. These surveys have been done by both private consultants and university students from the nearby Southern Cross University. The current bird species count stands at 135 and is expanding.

Surveys on Main Camp have indicated that there are two species regarded as endangered present on the farm. These are:

- the giant barred frog, *Mixophyes iterates*
- the black necked stork or Jabiru, *Ephippiorhynchus asiaticus*

There are also a number of species present that are regarded as threatened in NSW. These are:

- barking owls, *Ninox connivnos*
- powerful owls, *Ninox strenua*
- rufous bettongs, *Aepyornis rufescens*
- large-footed mouse-eared bat, *Myotis adversus*
- square-tailed kite, *Lephoictina isura*
- glossy black cockatoo, *Calyptorhynchus lathamia*
- the Australasian bittern, *Botaurus poiciloptilus*.

Management plans are in place on Main Camp to ensure that both the habitat of these species, and numbers of animals are protected. Staff are familiar with these animals and report sightings at routine staff meetings.

A geomorphological study has shown that a shallow lake system existed on the property in recent geological history. The lagoons are remnants of this lake system.



A black swan nest on the edge of one of the dams. A variety of waterbirds nest on Main Camp.



Lemonade Lagoon, one of several lagoons on Main Camp

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Soil types on Main Camp are very diverse, ranging from sands to clays in some areas. Four major soil types are significant for production. The farm is generally flat and the majority of the property is only 25 m above sea level.



Myrtle Creek forms one boundary of Main Camp.



Melichrus adpressus, the large nectar heath occurs on the sandy rises of Main Camp.

Dry sclerophyll forests, dominated by a variety of gum and box species occur on-farm. Greening Australia has assessed the riparian vegetation zones and is developing species lists.

The riparian corridors are dominated by weeping myrtles (*Waterhousia floribunda*) as the gallery rainforest species, with a diverse array of understorey plants.

Large areas of grasslands are present on the farm, as are *Casuarina* and *Melaleuca* swamps. Significant patches of heath vegetation (dominated by *Banksia*, *Grevilleas*, *Leptospermum* and *Callistemon* species) support a range of species of understorey plants. The unusual large nectar heath (*Melichrus adpressus*) is found in very isolated pockets of the property. No farming is conducted in these areas of significant habitat.

Local seed provenances are collected and used for revegetation on the farm and in the riparian zones.

Bungawalbyn State forest and the Bungawalbyn Nature Reserve share boundaries with Main Camp. These areas are taken into consideration when making management decisions. The predominant tree species in the forests on and around Main Camp are spotted gums, ironbark, and forest red gum, which form a dry sclerophyll forest.

The farm also houses relics of past tea tree oil extraction equipment – wood-fired oil distilleries and the like. One of the older farm buildings is heritage listed.

The managers at Main Camp are working on correcting the inappropriate drainage installed during the past farm management and are concerned by grazing practices on nearby properties, which they believe are having an adverse effect on the riparian zones. They are working collaboratively to address these issues where possible.

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The Staff

Ross Garsden and Dennis Williams do the majority of the day-to-day running of the EMS, but all staff are involved in the system. Five staff members form the on-site management team, with six permanent casual field staff. Another six casual staff are employed as required. Main Camp is also supported by marketing and organisational offices in Ballina and Sydney.

Dennis has been involved in farming since childhood and has a tertiary degree in technical and mechanical engineering. His initial role at Main Camp was to ensure that the extraction processes for the tea tree oil were efficient and producing a consistent, top quality oil. The processing plant is now recognised as the most efficient and best in the world. Dennis's role has now expanded to cover management of the entire property.

Ross Garsden has professional qualifications in forestry and education and previously worked with Greening Australia. He was on the Farming for the Future Advisory Committee in 1994-95. He is a registered property planner and a qualified environmental auditor. He is a member of the Regional Vegetation Management Committee and serves on the Northern Region Private Forestry Committee. This committee is under the auspices of the Department of State and Regional Development.

Main Camp employs an agronomist, John Frazier, who holds a Diploma of Agricultural Science and is currently doing an Agribusiness degree through Southern Cross University. He is also involved in the WaterWise training program.

Staff on Main Camp are provided with training on machinery operations, loader/bailer handling, occupational health and safety, bush-fire emergency and the Work Cover Confined Spaces training course. Chemical handling training is provided for appropriate staff and some staff members have completed various managerial, planning and marketing courses.



The old methods of tea tree oil distillation and...



...the new – the state-of the-art distillery now used

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The Environmental Management System (EMS)

The EMS at Main Camp has been developed using the ISO 14001 Standard. While the company was already operating a QA system in accordance with ISO 9002, that system did not allow all business operations to be addressed under the same system. Building upon earlier work by Ross, Ian Kelly of IGC and Associates produced a draft environmental management plan in early 2000, which provided a snapshot of the status of operations on the property in terms of legislative compliance.

The formalised information gathering inherent in ISO 14001 was seen as a significant feature that would draw all business operations together.

Main Camp has a written environmental policy (available to the public) which in part states:

“We believe that sound environmental policy is the foundation of our competitive strength and benefits our customers, neighbours and employees by contributing to the overall well being of our surrounding environment”.

The main driver behind the desire to address environmental management was the need to ensure that Main Camp was operating on a sustainable basis. There was also a recognition that management approaches needed to be made consistent throughout the business, so that if Dennis Williams was unable to manage or if business ownership changed, the business would still be working towards the goal of sustainability. The EMS is now viewed as a major strength of the business and has moved the corporate thinking from daily issues to longer-term planning and management.

Two other drivers were important. The first was community perception about past land-clearing practices on Main Camp and tea tree oil operations in general. Although past vegetation clearance on the property had been done in accordance with local Government requirements, there was a negative community feeling about the practices.

The growing ‘green’ awareness of consumers, particularly from some Asian, European and American markets, was another important driver. As 95% of the oil produced at Main Camp is sold to international markets, this latter issue was of particular importance. Use of an EMS allows Main Camp to demonstrate that environmental issues have a high priority in all their management operations.

A workshop organised by NSW Agriculture in 1999 highlighted that Australian consumers were also becoming more demanding in terms of environmental management. This workshop helped Ross and Dennis to demonstrate to the owners of Main Camp that EMS was widely regarded as a useful tool to address environmental issues on farms, as it is in other industry sectors.

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Using the EMS process was also seen as a way of keeping abreast of changing legislative requirements. Ross's initial involvement in the EMS work was to ensure that all activities carried out on Main Camp were done in accordance with legislative requirements (for example, water licences). Dennis and Ross believe that the EMS has positioned Main Camp well to address increasingly stringent legislation they see looming in the future. They use a number of periodicals to keep up to date with changes in legislative requirements, including a fee-for-service legal update provided through the Internet by a legal firm in Sydney. Standards Australia provides a Standards Update (again via Internet) and further information about requirements comes from involvement in Catchment Management Committees and Vegetation Management Committees in the local area. Ross says that while the Australian Tea Tree Industry Association has an environmental policy applicable to all members it is not in the position to provide detailed legal information to members.

A number of environmental issues were rated very highly when the EMS was developed. The highest priority issue was to achieve sustainable production. Chemical safety, creeks, wetlands and riparian zone management, water use management and occupational health and safety all were the next highest priorities. Soil management (including erosion prevention), biodiversity (including feral animal and weed control) and pollution/waste management featured on the next level of attention. Air and noise pollution are lower priority issues due to the location of the property.

Other management tools employed on Main Camp are: ISO 9002 (since 1996); Hazard Analysis and Critical Control Points (HACCP); used since 1998); Good Manufacturing Practices, Cattle care (which was gained after the ISO 14001 certification) and Integrated Pest Management (IPM) and Integrated Crop Management (ICM) principles to minimise application of pest control chemicals.

A number of specific areas of management have changed on Main Camp as a result of EMS adoption.

Water management now has an increased focus on drainage and containment. Periodic flooding presents problems for both plant health and productivity, and potentially could cause run-off of tannins from mulch storage areas into waterways. All first flush waters from fields are contained on farm and drainage around mulch areas prevents tannin leaching.

Drought is now managed more proactively, with the aim of moving from extraction of water from creeks at times of low flow to improved water harvesting and storage at times of high flows. Increased water-use efficiency and improved water delivery assist in meeting this aim. The type of water licence has also changed to one that allows high-flow period extractions only, containment of first flush water and no pumping from creeks. The change to this licence was prompted in part by the fee structure, but also because the management believes that this type of licence promotes environmentally responsible water use.



Dennis Williams (left) and Ross Garsden at one of the four purpose built chemical mixing sheds located on Main Camp



Rear view of a mixing shed

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Chemical storage areas are located in flood free areas of the farms. The dedicated mixing sites have temporary storage boxes for chemicals, while the large chemical storage sheds all have separate bunding for different classes of chemicals. Each mixing shed has its own water supply tank (on the roof), temporary, lockable storage chests for chemicals and safety equipment, safety shower (right front external wall) with a sink with bunded sumps (rear of shed). Safety directions and instructions are displayed on the walls of all sheds.

All staff handling chemicals are trained and chemical use is detailed in specific instruction sheets. Spot spraying has been implemented as a company policy, as has a ban on the use of organophosphates and organochlorines (which is linked to the Cattlecare requirements).

A new relationship has been developed with chemical suppliers, who now take back all empty drums. Only the minimum amount of chemicals required are stored on the farm at any one time, with suppliers storing the bulk supplies at their depots and delivering on demand.



Replacing nutrients extracted by harvesting foliage is achieved by returning tea tree mulch to the soil. In many areas of Main Camp the soil is almost pure sand (centre).

Minimum tillage practices are now routinely used. Cultivation for weed control has been largely phased out, with cattle grazing and judicious herbicide use now used in combination with minimum tillage for weed control. Soil health indicators are used to monitor the changes in soil condition. These indicators are linked to benchmarked tree growth indicators, to balance inputs and outputs for the soil. Soil mapping is now used more extensively to better match land use to land capability.

Cattle have been brought back into the farming operations and are rotationally grazed. The use of livestock has seen a reduction in the costs of chemical inputs, fuel use and labour as cattle provide the weed control formerly achieved by herbicide spraying. Stocking rates are carefully managed to reflect seasonal conditions and Dennis believes that there is potential to increase the current herd of 250 to 500 head over time with sound management.

Waste engine oil (equating to around 500 l/year) is recycled. A 1000-litre container is used to collect oils from machinery maintenance, with an approved waste-handling contractor collecting oil periodically. Tea tree mulch is used as an absorbent material to assist in dealing with spills. Scrap metals are also recycled. Other pollution prevention strategies such as a chemical drift management program, bunded chemical storage areas and run-off containment all assist Main Camp to meet the ISO 14001 requirement for pollution prevention.

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Resource use efficiency is also being addressed. The improved water management practices are part of the story, but alternative energy sources are also being investigated. Bio-diesel, solar and the use of waste from forestry operations are all under consideration as potential fuel supplies. Feasibility studies on these potential fuel sources are currently underway.

Finally, the overall business features have also changed. Communication has been enhanced between the managers and owners of Main Camp and regulatory agencies, customers and neighbours. Planning is now conducted over a much longer time frame and a greater degree of monitoring, review and record keeping has been implemented. Contractors are now included in the management approach, with a clearly designed set of work instruction sheets assisting both management and contractors to ensure that environmental issues are considered at all times.

The EMS was developed using both in-house and consultant expertise. Ross Garsden used both the Queensland Farmers Federation Environmental Code of Practice and the Queensland Fruit and Vegetable Growers 'Farmcare' Code of Practice for information but found that the latter document provided more specific and useful information. The Bungawalbyn Catchment Management Plan was referred to, but did not provide any EMS guidance.

Specific manuals have been developed for use on Main Camp detailing various operations (such as IPM, distillation and boiler operations) and John Frazier describes these as the 'engine room' of the EMS – they provide both instructions and confidence in management practices.

The ISO 9002 procedures, developed as a quality program in the past, provided a good basis for the EMS and was the backbone of the initial management system. The organic standards followed earlier did not address the legal compliance issues that were of original concern, although aspects of the organic practices such as IPM were regarded as useful in building the new management systems.

Information on specific management issues to be included in the EMS was gained from the NSW EPA, the consultants employed and from the personal experience of the managers at Main Camp. ANZECC Guidelines for specific areas such as water quality are referred to when setting targets for performance. Ross comments that the NSW EPA, whilst endorsing the adoption of an EMS, did not provide information on how to go about doing this. "*The EPA is the logical place to go for this information*" Ross says, adding that it would be good to have a 'one-stop shop' where farmers could get help when developing an EMS.

Observations of the decline in resources in the local area were also built into the planning of the EMS. The consultants, EMS auditors, the Environmental Systems Specialist with NSW Agriculture and the 1999 EMS in Agriculture workshop were useful sources of information on EMS specifically. The Institute of Foresters newsletter was also an important source of information.

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Monitoring

Ross uses MapInfo GIS software to keep track of the many records arising from pest monitoring, yields, irrigation and records of crop diseases. Microsoft Access and Excel are also used for keeping records.

One of the current projects at Main Camp involves the establishment of benchmarks for water usage in tea tree oil production. This is being done in collaboration with the WaterWise program to gain a better understanding of the real needs for, and costs of, water on the farm. The database of information for this project is being gradually built up over time. The managers are working towards collecting this data by telemetry, as currently it is a two-day job to check all the 47 field monitoring sites manually.

All staff have field note books to record any observations during their daily routine and all training records are on a paper-based system. The waste oil program, feral animal control baiting plans and progress are also kept as paper records. Most other records are kept on computer systems and fed into the MapInfo program managed by Ross Garsden.

Information collected through monitoring is fed back into management decisions regularly. Staff meetings occur every month and all staff have the opportunity to cover issues dealing with QA, EMS and OH and S during these meetings. Monthly reports are also sent to the Ballina and Sydney offices of the company. The marketing office receives these reports and contributes market intelligence regarding environmental issues of concern to customers back to the farm. The formalisation of communication is one of the major benefits arising from the use of the EMS.

ITEM	HOW OFTEN
Water quantity and quality	Weekly or fortnightly measurements are taken in each field by 'Gopher/Ferret' systems and piezometers. These are logged onto a PC and annual trend analysis of yield and water use done.
Soil moisture	'Gopher' system takes weekly measurements
Vegetation surveys	Rapid biodiversity assessments are done annually
Integrated Pest Management	Weekly crop walks are conducted from November to May, or whenever air temperatures during the day are over 17°C.
Soil condition – organic matter and nutrients	On-field testing for N, P, K conducted annually and occasional residue tests
Dip site and stock yard soils	Laboratory analysis of soil cores done as a one-off for Cattlecare
Surface run-off	1 L samples collected at sumps on an event basis. Laboratory analysis done
Turbidity, pH and temperature of water at sumps	1 L samples collected at sumps on an event basis. Laboratory analysis done for turbidity and pH.
Plant and tissue analysis	Samples from each part of plants taken and bulked for analysis, on an as-needed basis
Tea tree oil quality	Each batch sampled during processing
Financial assessment	Trend analysis of various treatments done as needed

Items currently monitored on Main Camp

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Benefits and Costs

The benefits of the EMS are hard to quantify, due to the currently depressed state of the industry and lower prices. Dennis states that the EMS has resulted in improved resource use and believes that by using a system, any potential environmental harm can be quickly identified and corrective or preventive action taken. In addition, the system can help to demonstrate that sound practices are in place to address environmental issues.

Two of the major benefits are the improved ability to demonstrate compliance with legislative requirements and the lowered risks and liabilities faced by the business. Dennis and Ross believe that the EMS has virtually eliminated the potential for fines for breaches of environmental legislation. They also believe that it will be easier to gain licences for various farm operations in the future.

The business is just beginning to use their environmental program in their marketing. The SGS 'Green Dove' logo will signal the use of a management system compliant with ISO 14001 and specific branding and eco-labelling of products is under development.

Main Camp has established an interactive web site, which features their 'production in harmony with nature' theme. Whereas there was confusion in the market place about what 'organic' tea tree oil really meant, the management at Main Camp believes that using both QA and EMS practices would help clearly define the features of the product they sell. The ISO standards are valued because of their international recognition. Ross and Dennis feel that their product has now become more highly valued in the marketplace but, so far, whilst maintaining sales, no premiums have resulted. The business is working towards achieving both premiums and preferred supplier status.

Other benefits perceived as arising from the EMS are the remediation and/or repair of infrastructure, the removal of obsolete equipment, improved communication with a variety of groups (regulators, community and customers) and an improved knowledge foundation on which to base future planning. Main Camp was also a finalist in the 2001 Banksia Environmental Award, Small Business Category for Responsibility and Leadership, resulting in considerable positive publicity for the business.

Finally, a greater confidence in management has resulted. Staff are now proud of their work environment and often bring friends and family members to see the rich biodiversity on the farm. This has resulted in increased participation and pride in the overall system of management. The EMS has resulted in a better integration of farming practices into the environmental management context, resulting in both farming operations that are more sympathetic to environmental conditions, as well as streamlined management approaches.

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Costs are somewhat easier to determine. Consultants have been engaged to provide various services on Main Camp. Ross Garsden was employed full-time to provide specialist EMS skills and support. Infrastructure and repair bills also added to the costs.

Fencing out of the riparian zones along Myrtle Creek cost approximately \$18,000. Some \$6000 of this was provided through a Greening Australia grant.

Overall, Ross and Dennis estimate that establishing the EMS and associated infrastructure changes initially cost around \$100,000 (roughly 3% of the gross operating costs). However, these costs will diminish, as the system is refined and the initial 'one-off' costs are met. To put the costs into perspective, the annual gas bill for operating the distillation unit is around \$500,000.

Regular external audits are carried out on the EMS, with an approximate fee of \$1100 per day charged. Combining the QA and EMS audits is reducing audit costs overall. There is also an additional annual registration fee paid to the certifying authority, which includes placement of the business details on an internationally available register.

The implementation of a management system has also highlighted the need for greater analysis of the costs of overall management. This has allowed savings to be identified. Initially, John Frazier was concerned that the business side of operations would be sacrificed for environmental considerations. He felt that significant costs would occur in addressing environmental issues. However, he is *"now much happier that managing the environment integrates well with overall management and is done at no particular extra cost"*.

Future potential costs related to the time needed to deal with regulatory agencies have now been reduced or avoided entirely. Trust has built up between the manager and local regulatory authorities. Ross and Dennis believe this will be a major benefit for the business in the future.

The Future

Ross and Dennis recommend that other farmers begin to develop a systems approach to resource management. They advise starting off simply and recognising that not all issues can or need to be dealt with at once.

They also recommend using a well-known and respected Standard. *"By working to stringent standards, everyone knows what is being done, rather than having to rely on word-of-mouth to get that understanding"* says Ross. *"ISO 14001 provides a platform for managing and maintaining a system and for giving some certainty that the system will prevail into the future"*.

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However, for more farmers to adopt EMS, Ross and Dennis believe that most Government agencies and industry groups need to improve the amount of information provided on EMS.

Various financial incentives would also help. Ross suggests a system of tradeable tax credits as a possible option as it's "*equitable across the landscape*" and equally shared by the whole population. Such a system would allow an environmental benefit to be rewarded regardless of the size of the enterprise or tax status of the farmer or landholder.

Increased speed in licence and development application processing is potentially another area that could be used for encouraging farmers to use EMS.

Ross sees an increase in the requirement for accountability in environmental management and performance in the future. "*Commitment to continuous improvement is an inherent feature of ISO 14001 Standard and requires constant monitoring of performance*". Although tea tree producers must in theory comply with the Industry Environmental Code of Practice, there is no formal check on this at present. Ross believes that the industry must proactively engender a systems approach to management. He feels that this will help provide both credibility and respect for the industry. Advertising to drive consumer purchasing of 'green' products will create a market incentive for farmers to get involved in EMS, but credible management must back up 'green' marketing. The use of an EMS on Main Camp has placed that business ahead of many in being able to meet such a market demand.

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Authors:
Gioia Small and
Genevieve Carruthers



Map of New South Wales showing
location of Ladysmith

Samarra - Dairy farming

Natural products produced with environmental consciousness

Syd Clarke

The dairy industry has gone through massive upheavals over the last few years with deregulation and lowering commodity prices. Many dairy farmers have exited the industry, whilst others have taken advantage of Commonwealth and State government assistance packages developed to help dairy farmers cope with the removal of regulated marketing arrangements.

Syd Clarke, a dairy farmer at Ladysmith, near Wagga Wagga in New South Wales is one of the farmers who have chosen to 'stick with it'.

Syd Clarke's property, Samarra, is a farm demonstrating a practical answer to some of the environmental problems that face dairy farmers today.

The Clarkes have had to deal with a number of environmental issues including the management of dairy effluent and salinity. According to Syd, salinity was the best thing that ever happened to him, because it made him stop and consider what was happening on his farm.

Syd Clarke recognises the importance of how his farm management will affect the community and he has adopted a policy of:

"Responsible management to reflect land stewardship."

Samarra has developed into a model farm for the dairy industry and the Clarkes are often hosts to dairy farmers, community groups, politicians and overseas dignitaries, who come to see how their environmental management approach works.

The Property

Samarra is a 275 ha property located close to Kyeamba Creek in the Kyeamba Valley. Syd's parents established Samarra in 1956 and since that time, the farm's management has changed considerably to include:

- a move from cultivation to direct drilling
- the establishment of a revegetation program
- the establishment of a wetlands area

The Clarkes run 150 cows and also rear calves and steers for sale. The property includes a dairy, two residences and assorted machinery and hay sheds. Irrigation on the farm is supplied from a bore and there are communities of yellow box and ironbark on and around the farm.



One of the herd at Samarra

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The Clarkes have planted 8500 trees on the farm themselves and through a joint venture with CSIRO and State Forests, they have established a 2 ha site to trial which species are the most useful to manage the rising water table in the area.

The farm is located in a region that is prone to salinity and this has become a key issue for the Clarkes. The management of Samarra can affect the local catchment. Similarly, the management of other farms in the district can have an impact on the Clarkes' farm.

The effluent produced by the dairy is another key consideration for the Clarkes and over the last few years, they have developed an effluent management program and effectively integrated that into the overall management of the farm.

The Family

Syd Clarke has been farming for over 40 years and for the last thirteen years he has actively participated in the local Landcare group with four years spent as the group's chairman. He is also a member of the Murrumbidgee Unregulated Streams Committee and is Secretary of the Wagga Wagga branch of the Dairy Farmers Association.

Syd is keen to take on new ideas and has done farm planning training through programs such as Farming for the Future and WaterWise.

The Environmental Management Program (EMP)

Syd Clarke rates water and vegetation as top environmental priorities for his farm. If he does not manage these in a sustainable manner, the long-term profitability and very existence of his farm will be compromised. According to Syd, pasture management, effluent management, revegetation and water are the key areas he must work at to remain sustainable.

The Clarkes identified that something had to be done to manage the effluent the dairy was producing. Before they made changes, the effluent from the dairy was being discharged straight onto the paddocks surrounding the dairy itself. This was degrading the soil as well as creating an unattractive area around the dairy. So Syd set out to find how he could better manage effluent to minimise the impact he was having on the land.



The dairy at Samarra



Solids are screened out before being directed into the first holding pond.

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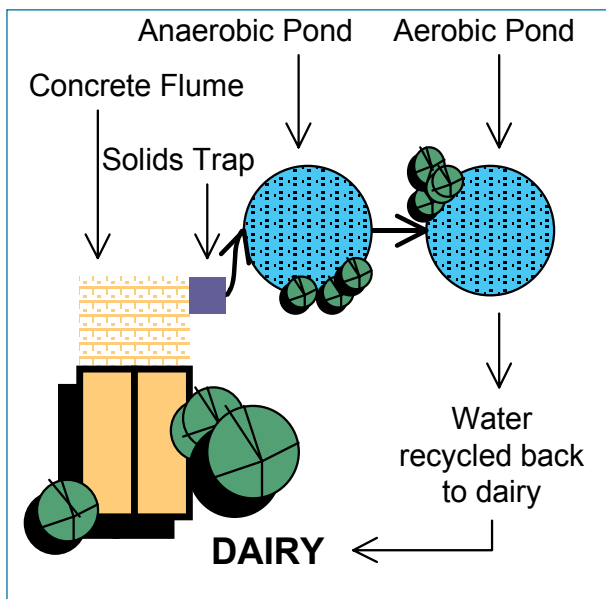


Diagram of dairy showing movement of effluent from dairy to holding ponds



The aerobic holding pond supporting a wetlands area

The solution to the problem was to create a system that includes flood washing, a solids trap and two ponds. The first pond is an anaerobic pond and the second pond is aerobic. Water from the second pond is pumped back to the dairy to fill the flood-washing system. The same water has been recycled continuously for the past six years.

When the dairy is cleaned after milking, the effluent is carried down a concrete flume to the solids trap where solids and harmful organisms are removed. The water then passes via an underground pipe to the anaerobic pond.

The water stays in the anaerobic pond for a minimum of four days and then it is moved to the aerobic pond where it must remain for at least thirty days.

Here the wetlands go to work utilising the nutrient-rich water for growth. The water is then recycled for cleaning the dairy yard and in some months, the treated effluent can be used for irrigating pastures.

Syd now manages dairy effluent, not as a waste product, but rather as part of a land management system that maintains and improves the sustainability of his farm. To help him understand what is happening in his overall approach Syd monitors the water quality every 6 months.

To better manage salinity on the farm, the Clarkes have commenced a revegetation program, locking up portions of revegetated areas around creek lines. These areas are crash grazed to keep the vegetation under control.

The revegetation program that has been adopted means that the Clarkes will be able to manage the water table more effectively, thereby reducing the salinity problems on their farm.

Monitoring

Most of the monitoring on Samarra involves the condition of water. Biological oxygen demand is measured every 6 months, as in water quality. A close check is kept on trends in the condition of the waterways. Records are kept on paper.

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Benefits and Costs

The Clarkes are sure that the changes they have made will ensure that they are still on the farm for many years to come.

The health of the soil on the farm has improved and there are no longer degraded areas of land because of poor effluent management. The wetlands that were established to capture nutrient runoff have become a habitat for native flora and fauna.

The farm the Clarkes have established means that they can demonstrate to their customers that their products are environmentally friendly. According to Syd, this has improved their market access.

It cost around \$15,000 to establish the effluent management system at Samarra. The Environmental Restoration and Rehabilitation Trust helped out by providing funding that enabled the Clarkes to set up a model to employ best management practice in the dairy industry.

The model farm that has been created will benefit the entire dairy industry in New South Wales as it enables farmers to see how EMPs on a dairy farm can be implemented in a very practical manner.

The Future

Syd believes that consumers will continue to select products because of their 'greenness'. Consumers want products that are healthy and clean and will seek out products that fit these criteria.

The dairy industry has become more proactive in this area over the last few years and has developed Waste Management Guidelines in recognition of the need to be environmentally conscious.

In the future, the Clarkes will be setting benchmarks for environmental performance, as well as actively implementing the Land and Water Management Plan developed by the Kyeamba Valley Landcare Group.

Syd believes farmers must be accountable for their farming practices and demonstrate responsible land stewardship to ensure their future in the dairy industry. Syd Clarke is one farmer who is making inroads into building an industry that can show its commitment to an environmentally sustainable future.



A revegetated area near the creek

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Map of New South Wales
showing location of Yanco



Entry to Rockdale feedlot at Yanco

Rockdale Feedlot

Managing their impact on the environment to ensure a sustainable future

Peter Paradice and Paul Troja

Australia is the world's largest exporter of beef. Over one million tonnes are exported annually with major markets in the United States and the Asia-Pacific region.

The Japanese market is worth \$1.3 billion annually and the demand in this market is for a grain-fed, marbled beef product at the high quality end of the market. Rockdale feedlot located at Yanco in the heart of the Riverina region in New South Wales is one of the companies that supply the exacting requirements of the Japanese market.

The management at Rockdale has recognised that in order for their business to remain profitable, it must recognise the needs of its stakeholders including customers, community and regulatory bodies.

Rockdale has adopted a policy that states:

"Our environmental certification program will take precedence over any other commercial considerations."

To meet the varied needs of its stakeholders, Rockdale chose ISO 14001 as the standard for its environmental management system.

The adoption of ISO 14001 has ensured that Rockdale fully understands the effects its daily activities have on the environment and strategies are in place to:

- prevent environmental degradation
- protect the health and quality of life of its stakeholders
- continually improve environmental performance.

The Property

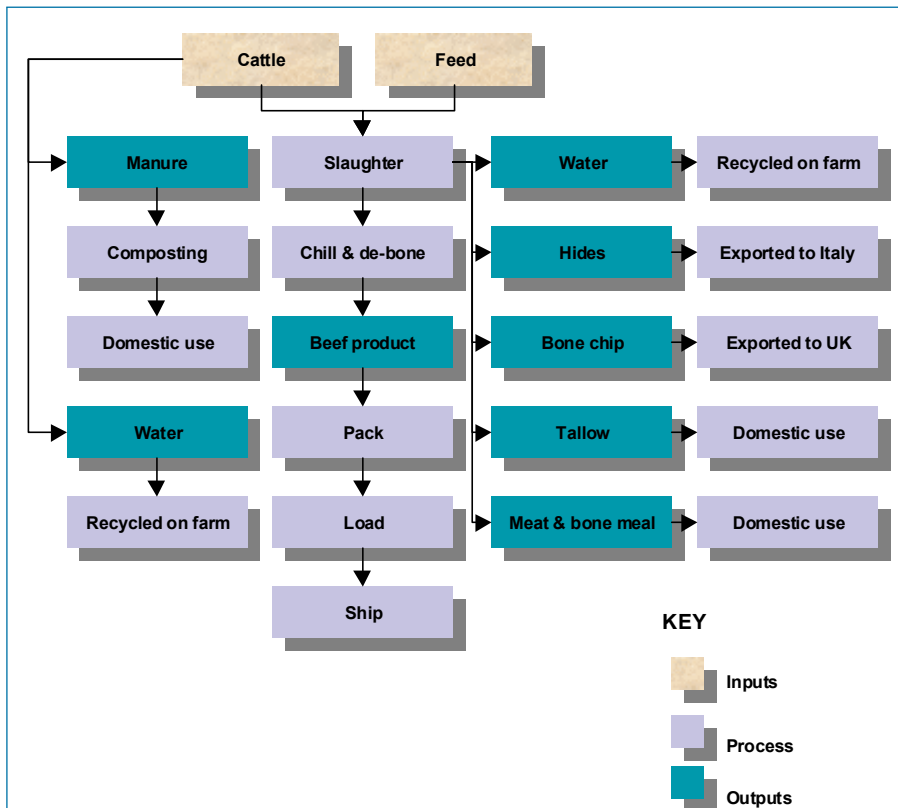
Rockdale is a 2000 ha property owned by a partnership of Mitsubishi and Itoham Foods, a company that concentrates on fresh and processed meat products.

Established in 1991, the feedlot was originally stocked with 5000 cattle. Today, Rockdale has grown to a 53,000 head registered feedyard. The feedlot is located on a part of the property that forms a natural amphitheatre. This provides excellent drainage and run-off for the cattle pens.

Young cattle are purchased from Southern New South Wales and Victoria and are fed with grain mixed at the feedmill on site. The cattle remain at the feedlot for anywhere between 100 and 300 days, depending on the requirements of the market they are destined for. They are then processed at the abattoir and exported to Japan for both home consumption and the restaurant market.

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The key processes, inputs and outputs, at Rockdale

Rockdale has 80 ha of pens and a state of the art abattoir. The remainder of the area is taken up with cropping, agroforestry and a host facility for visitors. The company produces around 3,000 tonne of oaten silage and 11,000 tonne of corn silage for its own use each year.



The golf course is part of the host facility and is used by clients and staff



The pens at Rockdale

A feedlot and abattoir facility has the potential to have a significant impact on its immediate environment. The figure above highlights the major inputs and outputs as well as the processes involved at the Rockdale feedlot. Clearly, there are major outputs, such as water from the

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abattoir and manure from the pens, that have to be managed correctly to ensure that there is no adverse effect on the environment.

The Staff

An environmentally aware core of about 50 people operate the Rockdale Beef feedlot. Paul Troja is the General Manager and has a lifetime background in the meat and livestock industry. A multi-skilled management team has been instrumental in developing management systems for Rockdale feedlot.

The feedlot has followed the abattoir to obtain certification with ISO 9002 as its Quality Assurance (QA) system. General management team members took training in the development of ISO 14001 several years before achieving certification under ISO 14001 in March 2001. According to Paul, the groundwork that had been done in the implementation of ISO 9002 made developing the full EMS a lot easier.



The abattoir wastewater plant

The Environmental Management System (EMS)

The major environmental concerns for Rockdale feedlot revolve around some of the outputs that are produced as part of the overall production process. Wastewater, run-off from the pens, odour and disposal of manure are just some of the issues Rockdale has had to deal with.

The abattoir produces a lot of wastewater that has to be managed. Once the water leaves the abattoir it is directed into a series of holding ponds where the process of improving water quality begins.

The wastewater enters the ponds with a biological oxygen demand (BOD) of 4000 and leaves the ponds with a BOD of 48. The water is then recycled to irrigate the cropping areas on the farm.

All the cattle pens have a compacted clay layer overlayed with a manure pad. The compacted layer ensures that there is no leaching of nutrients and water into the groundwater. All the pens have concrete drainage channels around their perimeter to deflect run-off into sedimentation basins.

This run-off is shandied with fresh water and is also recycled on the farm.



One of the sedimentation ponds at Rockdale

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Odour can be a problem for the local community and the management at Rockdale take it very seriously. To manage odour, air from the abattoir is pumped through a biological filter made of rice hulls. This removes odour particles and ensures that odour problems are minimised.

However, should a problem occur, Rockdale has a 24-hour telephone number that members of the public can contact. If an odour incident occurs, a member of Rockdale management responds immediately.

Manure disposal has been addressed through the manufacture of composts. The manure pad from the cattle pens is removed periodically and then



The biological odour filter made from rice hulls

and then composted in windrows. Once the composting process is complete, the composts are sold to farms, vineyards and nurseries.

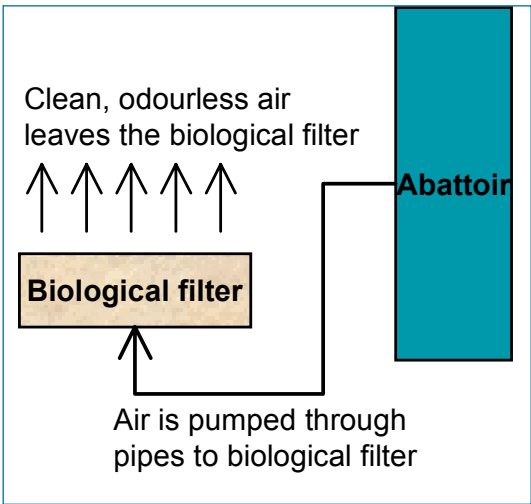
Monitoring

Rockdale employs a rigorous monitoring program to ensure its EMS is working. The table below highlights some of the monitoring that takes place at the feedlot.

ITEM	HOW OFTEN
Soil nutrients	Soil tests are conducted annually
Water usage	Meters take daily measurements
Water quality	Monthly, quarterly or annually depending on level of risk
Water table	Test wells, assessed quarterly or annually depending on risk
Noise	Meters test periodically at farm boundaries
Odour	Ongoing, monitored through complaints received

Schedule of monitoring activities

Monitoring issues like soil nutrients and water quality means that the company can keep track of how well their EMS is working. Word and Excel programs on computer keep track of records. They also undertake a review of their EMS each year. This enables them to review any new legislation and use the data they have collected through their monitoring activities to plan for the future.



Odour management using a biological filter



The composting manure in windrows

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Benefits and Costs

The benefits in having an EMS such as the one Rockdale has adopted are clear. Because of the improved management of wastewater, the use of freshwater is kept to a minimum, thereby reducing costs and demand on water. Being able to produce some of the company's silage needs using wastewater also cuts down on the amount of feed Rockdale has to buy in.

The odour management system means that the local community enjoys a better environment to live in. Rockdale is also better able to meet the legislative requirements of the Environmental Protection Authority.

The recycling of animal manures into a commodity that can be marketed not only provides Rockdale with a source of income, but also a useful method of disposal for this by-product. Both Rockdale and other industries enjoy the benefits.

Rockdale has made a substantial commitment to its EMS and there have been costs associated with its implementation. Staff need to be trained to ensure they are aware of the company's goals and objectives. The high degree of monitoring has meant that substantial funds had to be injected to purchase monitoring equipment.

Rockdale uses a consultant to keep it abreast of changing legislation and there are always annual audits to ensure the company is complying with ISO 14001.

The company has recognised the needs of its stakeholders. To meet these needs, Rockdale has to be environmentally sustainable and this in turn means that the company will remain economically sustainable.

Had Rockdale not made an investment in an EMS, it would find it very difficult to comply with legislation as well as live in harmony with the local community.

The Future

The management at Rockdale see their future as a cycle of continuous improvement brought about in part by their EMS. They will continue to monitor and recognise stakeholder needs and plan their activities according to meeting these needs. Paul Troja believes that the company will be judged on the recognition of the environment in its production system. Consumers vote according to how well their needs are met. Rockdale considers a primary customer need is good management of the environment, whilst at the same time delivering the product quality that customers have come to expect.

Rockdale has established a high level of environmental management as part of its production system. Without a doubt, other feedlots in Australia will have to follow suit.

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Old Coree – Rice Growing

Reducing the impact on the environment

Russell Ford

Authors:
Gioia Small and
Genevieve Carruthers

Rice is one of Australia's main cereal crops and is produced in the Riverina region in New South Wales. The Australian rice industry produces around 1.3 million tonnes of rice each year and in 1999 total exports of Australian rice were worth \$409 million.

One rice crop is grown each year and cultivation begins early in September. Rice is grown in bays and the seed is sown directly into dry soil or dropped into flooded bays by aircraft. Water is maintained in the bays during the growing season and is increased in level just before early pollen microspore stage of the rice crop, to help insulate against cold damage. Harvesting of the grain occurs from February right through to May each year.

Rice can only be grown on soils that have been approved for rice growing. At least three metres of continuous heavy clay are required before the farm is able to put in rice. If the soil type is permeable, often referred to as a 'leaky soil', then rice growing is either restricted or excluded. This ensures that water being used for irrigation does not move into the watertable.

The rice industry has often been criticised for its high water use, however, the average water consumption for rice growing in New South Wales has decreased from 15.25 megalitres per hectare in 1974/75 to 12.5 megalitres per hectare in 1994/95.

The Australian rice industry, through the Ricegrowers' Association of Australia, has developed an environmental policy and has identified the impacts that the industry has on the environment including:

- salinity
- chemical use
- greenhouse gas emissions
- energy consumption
- waste.

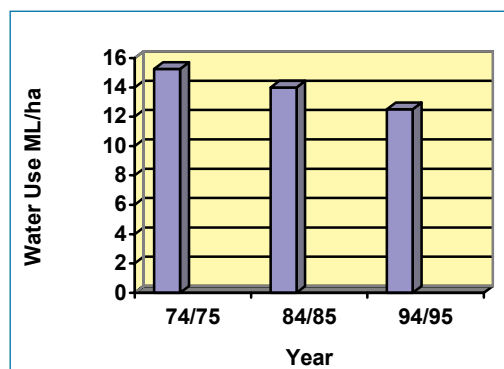
Old Coree is a rice farm near Jerilderie in New South Wales that is tackling some of these environmental issues head on. The farm has adopted a policy of:

"Conserving what we have and improving where we are going wrong."

The farm has set itself the task of becoming a Centre of Excellence for Farming Practice. To achieve this aim, Old Coree has adopted an environmental plan that deals with the key issues of water use, fauna and flora management and chemical use.



Map of NSW showing
location of Jerilderie



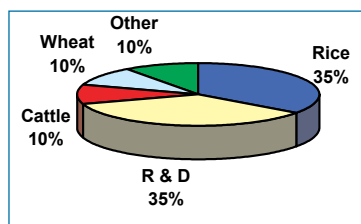
Water use in rice growing

Case studies New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
- Samarra
- Rockdale Feedlot
- Old Coree
- Boen Boe
- Eastwood Nurseries
- Bartter Enterprises



A rice bay at Old Coree



Income derived from various activities at Old Coree

The Farm

Old Coree is an 1830 ha farm that was established in the 1860s by the McCaughey family and is owned by the McCaughey Memorial Institute – a non-profit Trust founded in 1944 in memory of the McCaughey family members killed in action during World War II. In 1989, Rice Research Australia, a subsidiary company of Ricegrowers Co-operative Leeton assumed occupancy of the farm.

Today, the farm's core activities include:

- rice growing
- rice research and development
- cattle and sheep
- wheat growing
- triticale production.

The percentage of income from each activity is represented in the graph (left). The majority of income comes from rice growing. Rice grown at Old Coree is sold to both the domestic and export markets.

The soils at Old Coree are clay to clay loams and can be sodic and dispersive. Vegetation communities on the farm include river red gums, grey box, black box, swamp box, cypress pines, saltbush and assorted native grasses. Six ha of native trees have been planted out and a further six ha are planned for the 'leaky soils' on the property. There are also pockets of swamp totalling 80 ha.

The property incorporates a homestead, two employees' houses, workshops, seed-cleaning silos and a woolshed.

The farm has a water allocation of 2240 megalitres. This includes two irrigation licences for 970 megalitres each and a high security allocation of 300 megalitres. A 280-megalitre dam provides on-farm water storage. The Billabong and Yanco Creeks are located close by.

The Staff

The manager of the farm is Russell Ford. Russell has been farming for 20 years and completed a Diploma of Applied Science in Agriculture at Horsham in Victoria. Since then Russell has completed numerous courses relevant to farming including marketing and risk management. He completed a Nuffield Farming Scholarship during 2001.

Russell has a heavy involvement in the local community and is a member of the Jerilderie Risk Management Group, the Rural Industries Research and Development Corporation Rice Research and Development Committee and is a delegate on the Yanco Creek and Tributaries Advisory Council and Murrumbidgee Customer Services Committee.

The Assistant Farm Manager is Chris Quirk. Chris also has tertiary training in Agriculture, having studied at Hawkesbury Agricultural College.

Case studies – New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
- Samarra
- Rockdale Feedlot
- Old Coree
- Boen Boe
- Eastwood Nurseries
- Bartter Enterprises

The Environmental Management Program (EMP)

The main environmental issues for Old Coree are:

- keeping water and nutrients on the farm
- management of fauna and flora
- using alternative chemicals that are less toxic to the environment.

Improved technology over the last few years has ensured that only land that is capable of sustaining rice farming is utilised for that purpose. EM surveys have been used to identify 'leaky soils' and those soils are no longer used for rice farming.

EM technology involves the use of electromagnetics to map out different soil types on a property. In the past, soil surveys were used to provide soil maps for rice farms. However, soil surveys only provide part of the information as soil pits are dug on a grid basis and the soil profile is described for those points only. The advantage of an EM survey is that a complete soil map can be generated and there is no possibility of missing problem areas.

The staff and management at Old Coree want to set an example of Best Management Practice on their farm and consequently operate a closed system. No water or nutrients are allowed to leave the farm. Ninety per cent of the water being used on the farm is recycled and soil nutrients are monitored regularly to ensure that excess nutrients are not leached into the environment.

Fauna and flora management is also high on the list of priorities for Old Coree and a revegetation program has been implemented to regenerate areas of degraded land. Previously these areas had been grazed by sheep and were in a state of decline. However, since those areas have been fenced off to exclude stock and controlled grazing techniques used, the natural vegetation is regenerating and these areas will be able to be used again in the future.

Monitoring

To underpin the environmental management program on the farm, a set of monitoring procedures has been implemented.

Soil and water quality is monitored regularly to ensure that these precious resources are being looked after. The National Parks and Wildlife Service, as well as a team from the University of Canberra, has played a pivotal role by providing assistance with the flora and fauna management monitoring.

Case studies **New South Wales**

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
- Samarra
- Rockdale Feedlot
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Russell Ford examines some of the bush regeneration at Old Coree

Benefits and Costs

The changes in environmental management at Old Coree have provided a number of benefits. Soil and water health has improved and with that have come better yields and consequently better profits. Improved land management practices in rice growing have meant an extra profit somewhere in the vicinity of \$200 per hectare without extra expense.

The physical environment has benefited enormously and Old Coree is now seeing regrowth of Boree timber and a return to a more sustainable farming system.

There have also been benefits because of the collaboration with government agencies and the local community. The approach that the staff at Old Coree has taken has meant that their dream of being recognised as a farm that is employing Best Practice Management is well on the way to being realised.

The changes that have been made over the last five years have meant that the staff at Old Coree needed more training. They estimate that about 5% of their time is spent learning. Another cost has been the purchase of computer software, at approximately \$2000. Finally, Russell estimates that approximately 10% more time is spent on administration.

According to Russell, they have been making big changes over the last five years and he estimates that they will continue to make changes for the next 15 years at least.

The management at Old Coree is convinced that the changes they have made will stand them in good stead, particularly in the marketplace. Having a farm that is viewed as 'clean and green' means that they can convince their customers they are 'doing the right thing' and continue to maintain and improve market access.

The Future

The Australian rice industry is keen to assure its customers and the community that they are undertaking a program of responsible land management and protecting the waterways on and near their farms. Russell Ford believes that water issues will continue to be the greatest challenge for the industry. The rice industry will continue to come under scrutiny on how it impacts on water supply and quality. The Ricegrowers' Association of Australia, under its Environmental Improvement Plan, is addressing these issues.

Consumers of Australian rice will want to be assured that the product they are buying has been produced with careful consideration of the environment. Russell Ford and his team at Old Coree are working hard to provide that assurance.

Case studies – New South Wales

- Red Braes
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Boen Boe Stud

Pig production and environmental sustainability—a business approach

David McLeod

Boen Boe Stud piggery is a 900 sow farrow-to-finish piggery situated in the Southern Highlands of New South Wales. The property is owned by Charles and Elvira Zammit and managed by David McLeod. Boen Boe is part of an integrated business. The Zammits are also part owners of Wollondilly Abattoir and own a wholesale/retail smallgoods factory in Sydney.

Boen Boe Stud has recognised that if it is to remain profitable and sustainable it must actively manage its impact on the environment. Boen Boe's environmental policy is to:

- “promote an understanding of the importance of improving our management practices to take account of the changing attitudes towards the environment
- be proactive in investigating new technologies to improve the environment
- look at ways our farm sector can be sustainable with the assets at hand
- actively seek knowledge to allow Boen Boe management to shape an environmentally sensible operating system”.

To achieve this goal, Boen Boe has developed a Piggery Environmental Management Plan (PEMP). The PEMP identifies potential environmental risks and details appropriate management, monitoring and corrective actions to be implemented to avoid undesirable impacts.

The general environmental impacts addressed by the PEMP are:

- amenity of nearby land users
- groundwater
- surface water
- flora, fauna and heritage
- soils.

The Property

The Zammit family purchased the 178 ha Boen Boe property near the town of Mittagong in 1978. The property had historically been used for grazing and pig, fruit and vegetable production. The holding was expanded to 549 ha by the purchase of two adjoining properties in the last 15 years. This allowed expansion of the piggery, with additional land then available for utilisation of piggery effluent.

The piggery complex takes up about 15 ha. A further 200 ha is under a cropping/pasture rotation and 160 ha under pasture for beef fattening. The rest of the property is native vegetation, of which the cattle have access to all but about 90 ha.

There are no permanent watercourses on the property, however it is situated in the

Authors:
Suzanne Robinson
and Genevieve Carruthers



Boen Boe is located in the Southern Highlands of NSW, near Mittagong.



Native vegetation tree line between paddocks

Case studies New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
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Some of the remnant vegetation that has been retained in the gully country at Boen Boe

outer catchment for Warragamba Dam, which is Sydney's drinking water supply. Nutrients and irrigation from the piggery can potentially impact on the catchment if not managed properly. This makes it essential that environmental care is taken seriously on Boen Boe.

The soils on the property are derived from sandstone. They have a clay or sandy to clay-loam surface, which is underlain by a clay or clay loam subsoil.

The property ranges from gently undulating to steeply undulating land, with deep gullies.

The surrounding State Forest and Crown Land are home to a significant number of vulnerable and endangered species. Boen Boe has retained areas of remnant stringy bark, gum and paper box, with a tea tree understorey.

Water for the piggery is supplied from a bore and there are several dams on the property.

With effluent produced by the piggery being the crucial consideration in environmental management, the development of the effluent management program was essential to the overall management of the property.

The Staff

David McLeod has been the Operations Manager at Boen Boe for the past ten years. David has worked in farming all his life. He has a bachelor's degree in Rural Science, has completed an Environmental Training for Piggery Managers course and is a member of Managers 2005, a piggery managers' information exchange group.

David is responsible for all staff on the property. The piggery manager has tertiary qualifications in agricultural science, whilst others have several years of experience behind them.

The Environmental Management Program (EMP)

The main environmental issues being addressed by Boen Boe are:

- soil nutrient management
- irrigation application management
- water quality
- odour impact on neighbours
- staff awareness training.

Nutrient management is of primary importance to the sustainability of Boen Boe. If nutrient and irrigation application is not managed properly, there is a risk of odour nuisance to rural residential neighbours, nutrient and salt overload in the soil, leaching into groundwater and run off into the catchment.

Case studies – New South Wales

- Red Braes
- Andamooka
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- Bartter Enterprises

Effluent treatment and irrigation systems are in place on Boen Boe and a number of strategies are used to minimise the risk of nutrient pollution to the farm environment and its surrounds.

David identified that reducing the volume and nutrient level of the effluent was a key factor in nutrient management on the property. A variety of techniques have been used to address this.

Liquid effluent loads have been reduced by:

- screening solids from the effluent
- recycling water from the facultative pond to flush the piggery
- diverting stormwater away from effluent ponds
- converting grower pigs and sows from conventional water-flushed housing to straw-based systems that create a solid by-product instead of liquid effluent
- improving the digestibility of the pigs' diet with additives, which has dropped the level of phosphorus in the effluent and helped reduce odour generation.

Nutrient overload of the soil was a real concern for Boen Boe. Extra land was acquired, which allowed more area for nutrient irrigation and spreading of solids. The flood irrigation system was replaced with a travelling drip irrigator for more even distribution of effluent and to minimise aerosols which could cause odour. The grazing system was replaced with a cropping regime so that more nutrient could be removed from the soil by 'cutting and carting' the crop. The additional benefit in this approach was that the effluent improved the soil characteristics and crop yields, the grain could be used for pig feed and the straw used for bedding in the pig houses.

Extra levy banks and effluent runoff catchment dams help to ensure any runoff that does occur from the piggery or irrigation area is captured and contained on farm. Also, temporary watercourses in the cropping areas have been put under permanent pasture and allowed to regenerate.

Even the new cropping system has been changed in the short time it has been in place. In the first year of cropping a conventional plough was used. This was changed to direct drill to minimise disturbance of the soil.



Eco-shelter housing pigs on straw



Facultative effluent pond water is recycled for flushing the conventional pig sheds.

Case studies New South Wales

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Monitoring

Monitoring is an important part of the PEMP, with results regularly reviewed and incorporated into management decisions in all aspects of the farm enterprise.

Monitoring focuses on ensuring nutrient balance in the soil and minimising nutrient runoff. The weather station on site helps in making daily decisions on whether to irrigate and spread or not.

As a component of the licensing of the piggery operation with the Environmental Protection Authority (EPA), Boen Boe is required to submit a compliance report to the EPA annually. The EPA has been so impressed with the environmental efforts of Boen Boe that it has publicly congratulated them in a media release.



Some of the retained native vegetation bordering the wheat crop

ITEM	HOW OFTEN
Soil	Annually
Water quality:	
Surface (creek)	Six-monthly
Groundwater (bore)	Annually
Effluent	Every six weeks
Climatic conditions	Daily
Solid by-product	Annually
Volume of irrigated effluent (metered)	When irrigated (generally daily)
Mass of solid by-product spread (T/ha)	When spread (generally daily)
Crop yield	As harvested
Community relations	As they arise

Schedule of monitoring activities

Benefits and Costs

David is sure that the changes made on the farm to improve environmental performance have been beneficial to the operation.

With increasing environmental regulatory pressure and growing numbers of non-farmers moving into the area, the PEMP provides a system for minimising risk.

Some of the financial benefits of initiating change include fertiliser, feed and straw cost savings through better use of resources on farm.

Improved worker satisfaction has been a surprise benefit. Staff enjoy their work more because they are more involved in decisions on the farm. The general feeling of doing the right thing is also very satisfying, as is seeing improvement in previously unproductive land using sustainable techniques.

Case studies – New South Wales

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The costs of substantial change have not come cheaply at Boen Boe. The change in production system to more straw-based housing and improvements in effluent management resulted in an outlay of around \$200,000 for the ecoshelters and supporting effluent and solids- spreading equipment. An additional staff member was employed to handle the irrigation and cropping workload. The weather station was around \$10,000 and the monitoring regime is an ongoing cost.

However, the costs of doing nothing would have been environmental degradation, problems with EPA and Local Council and productivity losses from soil nutrient and salt overload if the old practices had continued.

The Future

David sees at least another couple of years of work before the current planned improvements on Boen Boe are complete. He does not see environmental improvement ending there, however, and will continue to keep abreast of innovations in the industry.

In the future, David intends on being more sustainable in the cropping regime and moving more nutrients off site. He will also be considering greenhouse emission minimisation strategies.

David believes that it is only a matter of time until consumers recognise good environmental practice through their purchasing power and he sees the possibilities for environmental labelling of product from the piggery in the future.

David encourages farmers to get involved in environmental management systems and says, *“You will be surprised at the level of support on offer.”* Talking to the farming community around you and sharing knowledge and experience is particularly rewarding.

Boen Boe has taken the lead in adopting innovative systems to manage environmental impact. The future will see many other piggery enterprises adopting environmental issues into their business management systems for a sustainable pig industry into the future.



Wheat crop improvement from effluent spreading – lack of good spread on the right is indicated by poorer growth.

Case studies New South Wales

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- Bartter Enterprises

Authors:
Suzanne Robinson
and Genevieve Carruthers



Eastwood Nursery is located near Mangrove Mountain, on the Central Coast of NSW.

Eastwood Nurseries

Producing plants for the future

Virginia Brunton and Chris Miller

Eastwood Nurseries is owned and managed by Virginia Brunton and Chris Miller. They own a retail nursery at Eastwood in Sydney and have more recently developed the wholesale nursery at Mangrove Mountain on the central coast of New South Wales. This nursery grows plants in containers for the domestic market, with a lot of product going into farm forestry and regeneration.

Virginia and Chris realised they had a great opportunity to be innovative in developing the new nursery site at Mangrove Mountain. They wanted to produce plants that had the potential to create sustainable environments and improve human environments in the most environmentally friendly manner possible. Eastwood Nurseries environmental policy is:

"To produce plants in a manner that conserves the resources of the earth and the environment.

We are committed to limiting damage to the environment to the best of our ability.

We seek always to develop procedures and use materials that reduce environmental harm.

We believe that through continuous improvement we can develop an environmentally sustainable nursery.

We consider the effects of all our practices on the immediate environment, the down-stream environment, the source environment and the future environment.

We do not consider we have all the answers and continually seek improvements."

Eastwood Nurseries' environmental management system operates from this policy. The system addresses policy, planning, implementation and operation, monitoring and management review. The system is dependent on management and staff commitment.

The main environmental issues addressed by the EMP are:

- water management
- pest and disease management
- waste management
- resource management.



Eastwood Nurseries' open growing area on raised benches and polyhouse growing area for container plants

Case studies – New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
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The Property

Virginia and Chris purchased the 17 ha Mangrove Mountain property in 1995 and established the wholesale nursery on the site to expand their nursery business. Historically the property had held a citrus orchard, although it was removed 15 years prior to Eastwood Nurseries purchasing the site. The property was poorly maintained and not productive when Virginia and Chris took on the site. The opportunity to develop the site from scratch stimulated Virginia and Chris to develop a nursery that balanced efficiency with environmental outcomes.

Of the total 17 ha, about 6 ha are set aside for greenhouse and open growing areas with plants in containers. However, only about one quarter of that set aside area is currently used for production. Production is not yet at capacity and will be increasing over the next few years. Other infrastructure like roads, the dam and sheds account for 2 ha, with the remainder of the property being native vegetation.

There are no permanent watercourses on the property, only an ephemeral creek in the southeast corner below the dam. The farm is at the top of the catchment that eventually flows into the Hawkesbury River and is next door to an organic enterprise. Good management ensures that nutrients, chemicals and irrigation from the nursery do not impact on the environment off-farm.

The soils on the property are sandy, derived from sandstone. The property is gently undulating, sloping down to the southeast corner. The property was especially purchased for this reason, so that runoff from the nursery could be managed at this low point.

National Park surrounds the nursery on the eastern and western sides. The National Park is home to a significant number of species. The average 1220 mm annual rainfall supports the endangered giant burrowing frog and red crowned toadlets in the area. Eastwood Nurseries has retained areas of remnant casuarina woodland and low open forest to support biodiversity on the property.

Irrigation water for the nursery is supplied from the dam and recycled. Bore and town water are supplied to the property but not used for irrigation.

The container-grown plants require irrigation and nutrient input and pest and disease control. This has meant that the development of an efficient, contained production system and a management strategy that minimises chemical and fertiliser use and impact has been essential to sustainable development for Eastwood Nurseries.



Some of the remnant vegetation that has been retained behind the dam which stores water for irrigation of the plants

Case studies New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
- Samarra
- Rockdale Feedlot
- Old Coree
- Boen Boe
- Eastwood Nurseries
- Bartter Enterprises

The Staff

Virginia Brunton and Chris Miller have been the owner/managers of the Eastwood Nurseries wholesale site since its purchase.



Virginia Brunton and Chris Miller in front of the raised open growing area; the slow sand filter is on the tree line in the background.



Drains capture runoff from the open growing area and direct it to the wetland.

Case studies – New South Wales

- Red Braes
- Andamooka
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Virginia has been working in the nursery business for 13 years, having previously been an environmental and marine biologist. She has a Bachelor of Science degree, an Associate Diploma in Horticulture and a Master's in Sustainable Agriculture. Virginia is a member of the Nursery Industry Association and Tubestock Growers Group and has been involved with Sydney University research group in sustainable agriculture. Virginia intends joining the local Landcare and Catchment Management group when she and Chris move to the Mangrove Mountain property to live in early 2001.

Chris has been in the nursery business all his life. Chris's father started the nursery at Eastwood.

Virginia and Chris are responsible for all staff on the property. Most of the staff have TAFE Certificates in Horticulture.

The Environmental Management Program (EMP)

The main environmental issues being addressed by Eastwood Nurseries are:

- water management
- pest and disease management
- waste management
- resource management.

The promotion and development of environmental responsibility are mainly the concern of management. They are responsible for developing, supporting and resourcing the EMP, identifying and complying with legislation, researching the mechanisms for achieving the EMP, consultation and encouragement of staff and initiating the feedback process and continuous improvement of the system.

Water management on the property is a key priority. All irrigation water is collected, treated and recycled. The irrigation water is collected from all the growing areas into drains that direct the runoff water into the wetland. The wetland removes excess nutrients from the runoff water prior to it moving into the eight megalitre storage dam. The water then goes through a slow sand filter to remove plant pathogens before

being irrigated out onto the plants again. The nursery is self sufficient for water, requiring no input from ground or town water supplies.

Integrated pest management practices are used to minimise pesticide application. Biological control agents are used extensively. Nursery surrounds are maintained as natural vegetation areas, encouraging natural biological control agents such as birds, frogs, lizards and beneficial insects. Limited use of chemicals for weed management is possible by using mulch mats, mowing and hand weeding. All chemicals are stored in a sealed, bunded area. A slow sand filter is used to treat the irrigation water for plant pathogens, rather than treatment with chlorine or bromine.

Waste management is continually being addressed and improved. All waste is sorted into recyclable and non-recyclable items. All green waste is composted on site. This compost is then used on vegetable and propagation gardens. Plastic tube containers are returned to the suppliers or other producers for re-use. Broken dirty plastic pots, which at present cannot be recycled, are stored until an alternate solution to landfill arises. A deposit system has been set up for the propagation cell trays to encourage their return for reuse at the nursery.

General resource management issues are just as important to Virginia and Chris as the more site-specific issues. Renewable energy sources are incorporated where possible. Green energy sources of solar and wind power are favoured. Renewable or recycled materials are used when available. For example, coconut fibre and poultry manure, both waste products from other industries, have replaced peat in the propagation mix and recycled timber and road base were used in the construction work on-site.

There has been no clearing on the property and natural vegetation is encouraged. Biodiversity surrounding the nursery is encouraged and maintained through incorporation of a number of strategies into the management of the nursery, including control of feral animals and plants.

These strategies are all aimed to meet the targets set by Virginia and Chris for the site. These targets are to:

- eliminate nutrient discharge into surrounding creeks and groundwater
- eliminate pesticide discharge into surrounding creeks and groundwater
- eliminate sedimentation of surrounding creeks and groundwater
- manage pests without the use of environmentally hazardous pesticides
- prevent biodiversity loss on the property
- minimise waste generation
- minimise the use of non-renewable resources
- minimise the use of mined products.



Constructed wetland used to remove nutrient from all the nursery runoff water



Nutrients are removed from the runoff water in the wetland before flowing into the storage dam.

Case studies New South Wales

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Monitoring

In order to know if these targets are being achieved, a monitoring system has been put in place. The results of the monitoring are recorded and reviewed and management adjustments made accordingly. Virginia says that “*Monitoring maintains a constant vigilance over the operations.*”



Slow sand filter treats the irrigation water from the dam for plant pathogens without the need for chemicals.

Monitoring mainly focuses on water quality. Water quality measurements are taken from the bottom of the drain (showing water quality entering the wetland), each of the wetland cells, the dam, slow sand filter and the tap onto the plants. This monitors the effectiveness of the recycling and containment system. Bore water is tested to gauge groundwater quality.

ITEM	HOW OFTEN
Water quality: pH and EC N and P	Weekly Monthly
Pest and disease (numbers and species)	Daily
Water use (volume)	Daily
Pathogen control (baits checked)	Weekly

Schedule of monitoring activities

Results of monitoring are reviewed with the staff at a weekly meeting, where any issues are addressed and changes needed are discussed.

Benefits and Costs

Eastwood Nursery was set up from scratch as a model benchmark enterprise using best practice and available technology, with responsibility to the environment a key consideration in its development. The environmental management program has been an additional support in management of the farm and has provided confidence that the investment of time and money made by Virginia and Chris has been worthwhile.

Virginia has great confidence in the management of the farm as a result of having the EMP in place. She and Chris are sure that there is no nutrient or pesticide runoff, no contamination of the soil and that they are doing what they can to minimise waste. Their success is recorded and documented through the monitoring program.

The management program in place at the nursery has improved yields and plant health, producing more uniform stock. Savings in pesticide use have also occurred. Recycling of water, with no use of bore or town water, has resulted in savings that are sure to increase in the future.

Case studies – New South Wales

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Virginia gets a great deal of personal satisfaction from being responsible to the environment on and surrounding their property. The property has also been a useful project site for Virginia for her studies and TAFE teaching.

Occupational health and safety on site is improved with the reduction in pesticide and other chemical use on the property. The environmental management program has also proved a good communication tool between management and staff.

The general condition of the farm has improved substantially and land value increased accordingly.

The main cost for setting up the program was for infrastructure and capital equipment. The environmental considerations made in the establishment, construction and development of the nursery probably added an extra \$100,000 to development costs. Virginia says *"We could have saved \$20,000 on the wetland and \$20,000 on the dam, as well as other costs associated with setting up the drainage system, but we wanted to do it properly."*

Training costs for management and staff account for about \$10,000 and around \$5000 was spent on computer equipment for record keeping. Monitoring costs are about \$80 a month and administration about \$200 a month.

There were costs also in finding the right piece of land for the nursery. It took 2 years of searching before a site was found where the water fell to one point for containment and recycling of runoff water.

Virginia accessed a Rivercare grant that provided \$20,000 to increase the size of the dam, which was a great help. Virginia's off-farm income, accounting for about 50% of her total income, has also helped in the capital development of the property.

The Future

Virginia feels that there have been many benefits to having an environmental management program in place, making it well worth the effort of developing, supporting and maintaining the program. However, as yet there have been no market benefits from the EMP. Despite this, the Eastwood Nurseries environmental policy is sent out with Government contracts and an environmental statement is written on the bottom of the stock list which goes out to clients:

"We produce plants beyond our customers' satisfaction with minimal environmental damage."

Virginia recommends approaching the development and management of agricultural enterprise with environmental goals in mind. Environmental goals must fit in with



Runoff from the travelling irrigator is captured in drains under the raised bed open growing area for recycling.

Case studies New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
- Samarra
- Rockdale Feedlot
- Old Coree
- Boen Boe
- Eastwood Nurseries
- Bartter Enterprises

the production and financial aspects, but systems can be developed to address all these factors.

Virginia also suggests investigating access to grants that can be obtained when considering improvements to minimise environmental impact. There are some worthwhile grants available to help kick-start environmental improvement projects and Virginia recommends using those resources if available.

Virginia and Chris intend on continuing their push towards minimisation of environmental impact and improved environmental management. They are considering ISO certification and also intend addressing resource issues more in the future, with particular focus on their energy use and using renewable energy resources such as solar and wind.

Virginia and Chris feel confident in their future, because they have good infrastructure in place and a management system which is a great measure and tool for modifying management, and for providing documented evidence of their goals and results which achieve sustainable outcomes. They recommend others follow their lead.

Case studies – New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
- Samarra
- Rockdale Feedlot
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- Eastwood Nurseries
- Barter Enterprises

Bartter Enterprises

Poultry production with the environment in mind

Mark Taylor

Authors:
Suzanne Robinson
and Genevieve Carruthers

Bartter Enterprises is a vertically integrated poultry producer with feed mills, breeding facilities, hatcheries, grower farms, contracted grower farms and processing facilities. Bartter, originally based in the Griffith area, obtained Steggles Limited recently, taking over its operations in states throughout mainland Australia. Their new meat chicken breeder farm near Gloucester in the Hunter Valley region of New South Wales is a benchmark poultry farm development, an illustration of their business motto: *Quality. Innovation. Service.*



Bartter Enterprises are near Gloucester, NSW.

Mark Taylor is the Hunter Region breeder farms manager and is responsible for farm operations and the farm's environmental management plan. The environmental management plan has as its basis a commitment to the continual improvement of processes; the prevention of pollution where practicable; and meeting or exceeding the requirements of the relevant Local, State and Federal legislation. This is achieved by industry based technology review, monitoring of systems for pollution prevention and auditing of the site's performance in complying with the plan.

Bartter's environmental policy is:

"Bartter recognises the importance of the environment and is committed to carrying out its activities in an environmentally responsible manner.

The company's environmental commitments are to:

- *conduct its activities in compliance with statutory requirements*
- *communicate effectively with Government, the community and employees in relation to environmental issues when appropriate*
- *reduce pollution through the implementation of an Environmental Management Program (EMP)*
- *monitor and audit the performance of the EMP*
- *where necessary to modify operations to maintain environmental performance at the desired level*
- *promote environmental awareness among employees and ensure they are appropriately trained regarding the EMP and its implementation;*
- *ensure adequate human and financial resources are committed to effectively implement the EMP*
- *coordinate environmental management into the business plan and other management plans of the Company.*

The company seeks to attain continual improvement in its environmental performance and to demonstrate due diligence on environmental matters."



Bartter breeder layer sheds, with mountain views

Case studies New South Wales

- Red Braes
- Andamooka
- Oakville Pastoral Company
- Main Camp
- Samarra
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- Bartter Enterprises

Bartter's environmental management program operates from this policy. A key feature of the EMP is the identification of environmental aspects and assessment of environmental impacts on a continuing basis. Environmental obligations are incorporated also, including legislation, industry codes of practice and all licences and permits for the operation. Environmental objectives and implementation strategies are set, enabling the farm to meet these requirements. A monitoring and auditing system is in place to facilitate continuing improvement of the farm's environmental performance and its EMP.

The Property

The 85.2 ha Gloucester property was purchased in mid 1998 to be developed as a poultry breeder farm.

It had been run as an extensive cattle-grazing property until then. The opportunity to start from scratch and incorporate best available technology and management strategies into the development of a brand new facility was approached with enthusiasm by Bartter. As Mark states, *"There was a major environmental focus in the development of this farm."* An innovative meat chicken breeder rearing farm was developed, which has since been converted to a breeder layer farm.



Bartter breeder layer farm facility

As with the original development, the change to become a breeder layer farm required consideration to environmental impacts. For example, Bartter decided not to put in bigger feed silos at the request of the neighbouring Bed and Breakfast owner, considering his concerns about interference with the mountain views beyond the poultry facility.

Of the total 85.2 ha area, the poultry farming facility incorporates about 10 ha, with the remainder of the property used for steer fattening. The fertile meat

chicken eggs produced on the farm go to the Bartter hatchery and the cattle are marketed internationally.

The property and the surrounding land are undulating grazing land with native and introduced pasture species and scattered eucalypts. Bartter is undertaking tree planting on site to increase tree numbers. Fencing on the property has been rearranged to secure the poultry farm facility and improve utilisation of the paddocks by the cattle. Bartter has also added a residence to the site.



Screening tree planting along the perimeter fence of the poultry facility

Case studies – New South Wales

- Red Braes
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There are no permanent watercourses on the property, only a small creek traversing the site along the western boundary, which generally does not flow unless significant rainfall occurs. Good management ensures that nutrients, chemicals and irrigation from the poultry facility do not impact on the catchment.

The topsoil on the property is silty sand with traces of clay, with a hard silty clay subsoil on top of a very low strength conglomerate of gravel. The property is gently undulating, generally falling from south to north.

The Staff

Being a corporate owned property, the breeder layer farm falls under a hierarchical management stream. An environmental officer manages the environmental aspects of all of Bartter's operations, including the breeder layer farm. Mark Taylor is Bartter's Breeder Farms Manager for the Hunter Region and is based at the Bartter offices at Beresfield. Mark has 13 years experience in farming and originally worked in the processing plant before moving into farm management. Mark has a Bachelor of Science in Agriculture and has completed in-house company training. Craig Dawe is the Site Manager at the farm and has a degree in agriculture, as does Bruce Sun, the second officer in charge. All staff have safety and environmental awareness training.

The Environmental Management Program (EMP)

The basis of the Bartter EMP is their environmental policy. Using this as a guide, the next phase of the EMP is identification of environmental aspects.

Environmental aspects are elements of the organisation's activities, products or services that can interact with the environment. Those aspects identified were:

- emissions to air ⇒ dust, noise, odour, particulates, smoke
- release to water ⇒ surface water and groundwater
- waste ⇒ solid and liquid waste
- contamination of land and groundwater
- raw material and natural resources usage ⇒ energy audit (coal, gas and water).

After identification of the environmental aspects, an evaluation of environmental impacts was done. An environmental impact is any change to the environment, whether adverse or beneficial, resulting from the organisation's activities. This impact evaluation considered the scale of the impact, severity of the impact and probability of occurrence.



Tree planting around the breeder facility will help to reduce dust, improve visual amenity by screening the sheds, and improve biodiversity on the farm.

Case studies New South Wales

- Red Braes
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As a result of the impact assessment for the site, the objectives and strategies for each aspect of concern were set out in plans for the management of:

- air pollution
- noise
- odour
- stormwater
- solid waste
- liquid waste
- energy audit and
- emergency response.



Incinerator for dead bird and egg waste disposal

Many of the implementation strategies and actions in these plans overlap because one action often benefits a number of aspects.

Air pollution management incorporates the control of dust, particulates and smoke. A number of strategies are used by the farm staff to help control dust impact. These include containing dust within the sheds as much as possible by maintaining the tunnel ventilation fans and the tight seals on the sheds and keeping sheds as closed up as practicable. Also, road maintenance and limits on vehicle movement help to reduce dust emissions from the roads. Any gases released from pesticide and disinfection use are contained within the sheds and all equipment is cleaned within the sheds.



Breeder shed interior. Adjustment of drinker lines, evaporative cooling and ventilation helps ensure litter remains dry and odour is minimised.

Strict operating procedures are in place for the operation of the incinerator for dead bird and egg waste disposal. These procedures ensure the incinerator is used correctly and only during appropriate times of the day and weather conditions, to ensure smoke and odour do not cause a concern to neighbours.

Bartter have planted screening trees around the perimeter of the poultry facility and intend planting more trees on the property. These help prevent the movement of dust off site and visually screen the poultry sheds from neighbours, as well as improving biodiversity on the property and providing shade for the cattle. Lawn is also maintained around the sheds to minimise dust generation.

Noise levels are managed by ensuring noise-generating equipment is maintained and only run in working hours or for the minimum time required. Alarms are directed away from neighbouring properties, are responded to as soon as practicable and are diverted to pagers after 6 pm.

Odour problems are avoided by ensuring the floor litter is kept dry by management of nipple drinkers, evaporative cooling and ventilation systems. Strict diet control ensures the birds do not develop wet droppings and if a problem does occur it is reported to management to be fixed. No used litter is stockpiled on site and

Case studies – New South Wales

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mortalities and egg waste are frozen and removed to the rendering plant or incinerated on site, minimising odour generation and nutrient pollution.

Stormwater management aims to reduce the risk of contaminants entering the stormwater system. Stormwater has been segregated from contaminated areas and contaminants are contained to prevent contact with stormwater.

Stormwater from shed roofs is collected in dedicated contoured depressions and diverted away from the poultry sheds and into a catchment dam to prevent contact with potentially contaminated areas.

Solid waste generated from the site includes used floor litter, mortalities and egg waste, mechanical equipment and garbage. The used litter from the sheds is removed directly into trucks and taken off site. The litter-loading site is thoroughly cleaned to scrape up any spilled litter and no litter is stockpiled on site. Loads of litter and shavings are covered during transportation. The used litter is spread on other farms as fertiliser. Bartters record where the litter goes, so it is traceable.

Dead bird carcasses and waste eggs were formerly frozen for removal to the Bartter rendering plant, but the farm is converting to the use of an incinerator with an after-burner. Ash remaining from incineration will be spread on the property or disposed of with the domestic waste. Domestic waste is stored in a skip bin and taken by contractor to an approved land fill site.

Mechanical waste is removed from the site by the maintenance contractor and delivered to the plant at Beresfield for recycling or disposal.

A Biocycle system for the amenities block incorporates a filter so that the water produced can be irrigated out on to the lawn surrounding the sheds, or diverted to a wastewater storage tank in wet weather.

Runoff from shed washdown is collected in a drain in the shed floor, transferred to a storage tank and irrigated out onto pasture. Cleaning of farm equipment is also done inside the sheds to ensure all wastewater is directed to storage tanks. Bartter have also used concrete floors in the poultry sheds. These require fewer chemicals for cleaning and disinfection than compacted dirt floors, which are the industry standard. Bartter's standard operating procedures also help ensure minimum chemical usage. As much dry cleaning as possible is done to minimise the amount of liquid waste generated.



Wastewater storage tank, with stormwater catchment dam in background

Case studies New South Wales

- Red Braes
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The water used on the evaporative cooling pads on the poultry sheds is recycled through the cooling pad system, reducing water use and wastewater generation.

Any areas with the potential to contaminate stormwater, including the flammable and combustible liquid and chemical storage areas, have been bunded and a liquid waste disposal contractor used to clean up any spills if they occur in these areas. Any liquid spills are cleaned up promptly to prevent spread and chemical containers are returned to the suppliers.

An emergency response plan ensures that procedures are in place and staff are trained in the event of an environmental emergency such as a chemical spill or fire.

Monitoring

Monitoring is important to measure whether all these strategies and actions are working.

The first batch of layers is still in the sheds and at the end of the batch, when cleanout and washdown occur, the runoff wastewater will be tested to ensure the wastewater is not contaminating the soil. Other monitoring undertaken on the farm is listed in the table below.

ITEM	HOW OFTEN
Contaminants in waste water from shed washdown	First breeder cleanout, more if needed
Solid litter waste record of amount removed and destination	End of batch/flock
Solid carcase waste record of number of dead birds	Daily, transferred to computer weekly
Complaints register	As receive complaint
Soil test where waste water irrigated	First breeder cleanout, more if needed
Environmental performance audit	Annually
Noise, dust & odour	Following complaint
Legionella testing for evaporative cooling pads	Annually

Schedule of monitoring activities

The EMP is reviewed quarterly and a water usage review is held every two years to assess strategies for further reduction of water use. An annual waste audit is also conducted to ensure that the processes on site produce minimal waste; disposal methods employed are current and the most appropriate; and waste collection



Evaporative cooling pads on poultry sheds recycle their water

Case studies –
New South Wales

- Red Braes
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contractors for disposal or recycling are performing the task appropriately. All preferred contractors agree to follow environmental requirements and are supplied with a policy and procedures manual prior to commencing contractual duties.

Benefits and Costs

Mark has found that major benefits of having the EMP in place are lower risks and liabilities. Problems are less likely to occur and if a problem does arise it is detected faster and so is cheaper and easier to fix. The EMP instils great confidence in all the staff and the management of the site is excellent.

The EMP has made it easier to meet legislation and licence requirements. The environmental management plan helped the facility gain development approval. It has also ensured that the development and operation of the poultry facility has had no adverse impact on the resource base or biodiversity on the property.

Using the EMP has improved communication. Staff know what is happening all the time and Mark says Bartter have maintained good relations with the regulatory authorities and neighbours by consulting with them when making changes and adjusting planning to address their concerns. Bartter also consulted with their customers when planning the development.

Some of the costs associated with setting up such an environmentally responsible facility include an extra \$70,000 spent on infrastructure and capital equipment. This was spent on the dead bird disposal unit, wastewater disposal system and tree planting. Ongoing annual costs include about \$3000 for monitoring, \$500 for administration and \$100 for auditing.

Another cost was the purchase of the land. Bartter bought more land than they needed in order to get the separation distances around the poultry facility and from other poultry farms that they required. They could not find an appropriate 40 ha block and ended up with a 120 ha holding in order to meet their requirements.

The majority of the income from the site is obtained from the poultry, with 1% attributable to the cattle, which are only present to make use of the buffer area around the poultry facility. Being a corporate farm, investment in the property is not dependent on the income from this site alone.



The first flock of breeder layers are in the sheds. Monitoring of washdown water will occur when the birds are removed and cleaning and disinfection occurs.

Case studies New South Wales

- Red Braes
- Andamooka
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The Future

Bartter made the choice when developing this new breeder facility to be good neighbours, fit in with the community and comply with regulatory authorities. Mark is confident in the investment made by the company. The facility is state of the art and environmental and community issues have been addressed in its siting, development, operation and management.

As Mark says, “Environmental issues in intensive agriculture are becoming increasingly important, but by developing a long-term plan and control measures, the day-to-day management is easier because we know what is required. We can make long-term decisions because we know the environmental part of the operation is basically right. We are not getting hassled by the regulators. If we had not spent the time and money up front to set the facility and system up, we may have had regulatory pressure in the future and the cost of meeting regulatory requirements then would be much more than doing it from scratch now like we have done.”

Bartter are receiving no market indicators for environmental management, but Mark believes it is not too far away. Eventually the Australian industry will follow the UK and Europe and consumers will have a reasonable influence over environmental issues. There are already signals from companies like McDonalds, who are currently looking at animal welfare issues in the production of the food supplied to them.

Mark sees chicken litter disposal becoming an increasing issue for management in the future. There is a gradual clampdown occurring on spreading litter for fertiliser in the catchment area due to nutrient pollution concerns and alternative disposal techniques are likely to be required. One consideration has been putting poultry litter through power stations to take advantage of the energy levels.

Mark recommends that others design and manage their farming operation so that it has minimal impact on the environment. He believes the emphasis on the environment will increase in the future and thinks managers will be increasingly expected to assess risks and implement controls on farm. Having an EMS in place will help managers and their staff deal with this accountability, because the EMS sets out what is required, how to measure it and what direction you are heading in. As Mark says “*It is a record of our responsibility to the environment.*”

Case studies – New South Wales

- Red Braes
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- Bartter Enterprises

Bally Glunin Park

Wool and beef production: a 14-step plan to a sustainable future

Michael Blake

Bally Glunin Park is a wool and beef cattle enterprise near Hamilton in Victoria. Owned by the Blake family, it is managed by Michael Blake. Michael has developed a management system for the farm over the last 15 years to help ensure a sustainable farming future in a catchment at risk from salinity.

The management system is based around the mission statement for the farm, which is:

“...at all times to progress forward, with the highest priority on sustainability, leaving the property in a better condition than what it was when we took over.”

Michael has identified a number of issues that impact on the sustainability of his enterprise. These issues are addressed in the farm management plan. All these issues are linked to each other, so any improvement in one will often have a beneficial effect on the others also. The 14-step system for sustainability for Bally Glunin Park includes drought-proofing, fire risk reduction, fencing, water usage, pasture, salinity, production, genetics, revenue, quality assurance, health and disease, environment, trees, wildlife, and lifestyle.

A number of these steps directly improves the farm and catchment environment, whilst others have a more indirect effect on the environment.

Salinity and water table management are the biggest issues on the farm and Michael has been active in finding solutions. He has developed a number of strategies to work towards fixing the problem and realises a long-term approach is required to achieve environmental improvement. Continual encouragement comes from the obvious improvement of the farm.

The Farm

Bally Glunin Park is an 1820 ha property just outside Hamilton in western Victoria. Michael's grandfather purchased the property in 1921. The farm is primarily grazing pasture for 10,000 sheep and 450 head of cattle. Michael intends increasing the flock size to 15,000 and herd size to 600 head. Cereal oats are cropped in rotation with pasture, providing winter feed for the stock. Up to 40 ha go under crop, depending on the size of the paddock in rotation. There are 93 ha of lucerne pastures for silage production and this area will be increased to 180 ha over the next couple of years.

Authors:
Suzanne Robinson
and Genevieve Carruthers



Bally Glunin Park is located near Hamilton in Victoria.



Sheep yards and a dam fenced off from stock to encourage revegetation and wildlife



Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings



Reclaimed gravel pit areas have shallow topsoil over clay, with poor production potential.

Michael has developed 8 ha of shelterbelts on the farm. He has also set aside 80 ha of saline area for reclamation. This area is being fenced off and planted with trees over a three-year period. Stage 1 of this project is complete. Close to 30 ha have been sown to saline tolerant perennial pasture and 15,000 trees have been planted. Stage 2 will be undertaken in 2001 and includes planting another 15,000 trees over about 30 ha. Stage 3 will develop a similar area again in 2002 with seed stock. The property also incorporates 180 ha of reclaimed gravel pits, which have a low production potential of only 1DSE/acre.

The volcanic soil on the farm is from a basalt base and the property is flat to slightly undulating. The farm is open grazing land with scattered gums. Michael has been trying to regenerate native trees on the farm by fencing off areas from stock.

The farm is at the top of the Glenelg Hopkins Catchment. It has a spring-fed tributary running through it that only runs with winter rainfall. The tributary empties into Fern Hill Creek, which eventually runs into the Wannon River and then into the Glenelg River.

A high water table causes the salinity problem. Some of the 26 springs on the farm are only 10 cm below the surface. The saline area of the farm is 4800 ppm salt and is contributing salt into the catchment. Michael is doing a lot of work on the farm to try and lower the water table with the assistance of a grant scheme. The salinity problem in the district is estimated to be putting 8 tonne of salt into the catchment system annually and Michael is trying to ensure his farm is contributing as little as possible to that.

Whilst the Blake family own other properties including a forestry enterprise, they are run as separate enterprises and income from them is not used on Bally Glunin Park, which is self-sufficient.

Bally Glunin Park is accredited under a number of product quality assurance schemes, including Cattlecare, Flockcare, Dalcare, Clipcare and MSA. The farm is also Go Mark accredited, which is an environmental performance accreditation marketing scheme for agricultural enterprises.



The front gate to Bally Glunin Park displays the farm's accreditations.

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

The Staff

Michael Blake has been involved in the management of Bally Glunin Park for the last 30 years, but only took over completely from his father 5 years ago. He has worked in secondary agricultural industry and managed other properties. Michael studied business at agricultural college and has done further study in environmental management.

Michael is the founder and president of the Baimbridge Landcare group and involved in a number of industry, market and focus groups. Commercial companies and resource department staff have used Bally Glunin Park as a field trial farm for several research projects and this collaborative work has been helpful in providing innovative solutions to problems facing not just this farm but agricultural enterprises generally.

All the staff at Bally Glunin Park have farm chemical, first aid and occupational health and safety training as a minimum and agriculture apprentices are trained on the farm.

The Environmental Management Program (EMP)

Michael has developed an all-encompassing management approach that incorporates environmental principles as well as addressing other aspects of farm management. The main environmental issues addressed by the system are:

- salinity
- tree decline
- weeds
- soil health
- energy usage
- wildlife
- water usage.

The salinity issue is by far the main environmental problem on the farm and is being addressed particularly by the Glenelg Hopkins Catchment Management Authority Community Partnership Project on Bally Glunin Park. The aims of this project are to:

- control salinity on Fern Hill Creek
- revegetate the perimeter of the saline areas with salt-tolerant indigenous species;
- plant out the saline area with tall wheat grass
- improve the water quality of the catchment of the Wannon River
- create wetlands encouraging bird species, including broilgas.

Significant numbers of trees have been planted to help lower the water table and reduce the salinity problem. This has also benefited the biodiversity on the farm. In addition Michael has been working on a project with the Victorian Natural Resources Department developing salinity hazard mapping using the EM31 4WD quadbike system, the results of which will be useful for management of salinity on Bally Glunin Park.



The Glenelg Hopkins Catchment Management Authority Community Partnership Project aims to reclaim the saline area on Bally Glunin Park

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings



Tall wheat grass has been planted in the saline area.



Lucerne paddock and keyline water harvesting into dam

To help maximise the farm’s water efficiency, Michael has put in troughs for watering the animals and has fenced off the dams to protect them from pugging by livestock. He has also introduced keyline water harvesting principles to the farm. Michael has been working towards more responsible use of artificial fertiliser, ensuring correct nutrient rates are applied at the right time to minimise runoff and make sure nutrient balance of the soil is maintained. Soil and plant tissue testing help assure this. There is limited application of other chemicals. Lucerne production was moved from autumn to spring establishment to avoid pests.

Bally Glunin Park is always working towards improved drench efficiency and disease resistance in their sheep in order to decrease chemical usage. They have not had to use a backline product for external parasites for 4 years.

Soils have been identified and matched to capability use. The paddocks have been divided for rotational grazing. Minimum tillage practices are used and lucerne production has been introduced. These strategies have improved the soil and pastures and allowed increased stocking rates. This has freed up land previously required for grazing, so that regeneration of trees and habitat can occur and saline areas can be sectioned off for reclamation.

Waste management has improved on the farm. Recycling occurs wherever possible and the farm uses the knackery for dead stock, which would previously be buried or burned on site.

Michael’s interest in biodiversity has increased and he is encouraging habitat for flora and fauna on the property by fencing off dams and regeneration areas, as well as planting trees.

Monitoring

Monitoring is essential for assuring Michael that all the work he is doing to improve the environment on the farm is working. He has put bores in to monitor the water table and does other sampling and monitoring on site, as below. The monitoring results are reviewed continually as they come in.

ITEM	HOW OFTEN
Soil nutrient test	Annual in rotation
Plant tissue test	When changing management practices
Water table (test wells)	Every 3 months
Salinity (water samples)	Annual
Biodiversity (bird counts at monitoring sites)	Seasonally
Tree decline (count)	Every 10 years

Schedule of monitoring activities

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Benefits and Costs

The changes on the farm have certainly improved both the financial and environmental performance of Bally Glunin Park. The resource base is improving and this is only going to increase as the saline area is reclaimed, soils and pastures improve further and habitat areas develop.

The environmental management program has reduced risk for the farm. There are fewer problems and those that do occur are picked up more quickly by staff and management. This means that they are smaller and easier to deal with than would be the case if the program was not in place. Improved document continuity gives a better reference base to measure from, making comparison and decision-making easier. Michael says there is also more harmony within the enterprise.

Biodiversity is improving, with bird numbers and species increasing and beneficial insects like worms and ladybirds being more apparent.

Michael has gained a lot of kudos and publicity for the improvements on Bally Glunin Park. The property has featured on Landline and in The Farm Journal. Michael has found one of the great benefits of the system is the satisfaction, excitement and pride in seeing things come to fruition and the confidence it has given him in his management.

As for the marketing benefits, Michael is not receiving a higher price for his product as a result of the environmental management on Bally Glunin Park. The financial benefits from the program come more from cost savings during production. These savings result from reduced chemical use, savings in time taken to do things and in time taken to make decisions. *“Having the system speeds things up a lot”*, says Michael.

Bally Glunin Park has benefited from grants of up to \$37,000 from the Federal Government, State Government and the Glenelg Hopkins Catchment Management Authority to regenerate the saline areas on the farm. Michael will have invested \$50,000 of his own money into the salinity project and estimates that it has cost him \$300/acre to establish trees, fencing, water conservation and salt-tolerant pastures on the saline area.

Michael says he was initially investing about 1% of the farm income into environmental issues, but this would now be close to 8% and he will probably expand that even further.



Areas planted to trees on the perimeter of the saline area are fenced and a test well is used to measure the water table (white post).

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

The Future

Michael is confident that the environmentally sustainable management practices he has introduced on Bally Glunin Park are improving his farm asset. He is enthusiastically adding to and improving those practices. It is an ongoing improvement process.

Michael is becoming more adamant that sustainable farm management is the way to go for the industry and the environment will have an increasing priority in the management of Bally Glunin Park in the future. Michael wants to increase tree numbers on the farm, to cover 15% of the land area and would like to get broilgas and red-tailed black cockatoos back into the area by providing habitat for them.



Degraded saline area that will be improved in Stage 2 of the salinity project

The holistic management process in place for Bally Glunin Park is working and Michael will integrate the system further into one stand-alone document.

Michael believes marketing of product based on environmental management will become more important, which is why he is setting up for it now. He also thinks that environmental performance will become a bigger aspect in bank lending decisions.

Michael is confident in the future of Bally Glunin Park. What he is doing feels right and the visual picture he has of the farm is exciting to him. He wants to see it come to fruition and encourages other farmers to imagine an environmentally sustainable future for their farm. *“Put a plan in place and get started and you will soon see your vision evolve into reality”.*

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Moffitts Farm

Biodiversity in small-enterprise farming

Pat and Anne Francis

Authors:
Suzanne Robinson
and Genevieve Carruthers

Moffitts Farm is a beef and forestry enterprise near Romsey, north of Melbourne in Victoria.

The property is owned and managed by Pat Francis and his wife Anne, who are also trialing lavender species on the farm for potential commercial production of lavender products.

The property was quite barren and windy when Pat and Anne bought it 12 years ago. They decided to start improvements on the farm by revegetating the property to provide weather protection for the cattle. Pat and Anne noticed other benefits from having trees on the farm and as a result, their focus and interest in environmental improvement and biodiversity increased.

Pat went on to develop an environmental management program for the farm, in conjunction with the development of a cell-grazing system and forestry enterprise on the property.

The EMP is a simple system based on continual improvement that Pat keeps building on to help him achieve the goals he has set for his farm. Pat's environmental policy is:

"We aim to produce a quality product and achieve ecologically sustainable production of beef, timber and lavender on 'Moffitts' by minimising direct and indirect environmental and social impacts and conserving our natural resources."

This policy is supported by environmental management objectives. The objectives set for Moffitts Farm are to:

- improve biodiversity above and below the soil surface
- ensure water quality is not degraded by management of the property
- ensure air quality is not degraded by management of the property
- enhance carbon sequestration above and below the soil surface
- minimise emission of greenhouse gases
- minimise the use of pesticides and fertilisers
- avoid pollution of soil, water and air
- minimise water 'leakage' below the root zone of the plant
- ensure only enough water is retained in farm dams to meet requirements of livestock and domestic purposes.



Moffitts Farm is near Romsey in Victoria.



Treed habitat corridors and improved cell-grazed pastures on Moffitts Farm

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Through a process of continual improvement, Pat is committed to achieving these objectives by:

- preventing pollution of land, water and air by adherence to government regulations and industry codes of best practice and through continual improvement of our farming operations using realistic and achievable guidelines
- protecting native fauna and flora in all areas of farm operations
- dedicating human and financial resources to fulfil our environmental goals
- minimising the volume of waste generated on-farm and implementing recycling opportunities wherever possible and practicable
- using the most appropriate indicators available to monitor farm operations and document our environmental progress
- informing all family members and contractors of their environmental responsibilities, through training and communication.



Lavender trial plots

The Farm

Pat's father, Ken Francis, acquired the 50 ha property in 1950 as an additional block to the existing family farm. The property was used for cattle and sheep grazing up until 1988, when Pat and Anne purchased the block from Ken and started Moffitts Farm.

Pat introduced cell grazing for cattle production and planted forestry trees on the farm. Anne has been trialing several lavender species, looking into the possibility of growing lavender and marketing lavender products.

Of the total 50 ha, about 6 ha are under farm forestry. Some forestry tree species are also mixed in with the habitat species in the 2 ha of shelterbelts and corridors on the farm. The forestry trees on the property include shining gum, Sydney blue gum, Tasmanian blue gum, southern mahogany, *Casuarina*, blackwood and cypress pine. Species planted for habitat on the farm include black wattle, blackwood, *Melaleuca*, *Casuarina*, *Callistemon*, *Banksia*, manna gum, eucalypts and wattles.

There is 1 ha of trial lavender plots and the house, sheds, roads, dams and horse paddock account for about 2 ha. There is a small remnant lucerne paddock and the remainder of the property is grazing pasture for the 30 breeding cows and 30 yearlings, which are sold domestically.



The younger 1998 forestry plantation with silage in foreground

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Currently all the income from the farm is derived from the cattle. The farm forestry is long-term and the first harvest will not be until 2020. The lavender enterprise is only at the trial stage and does not provide any income yet. Whilst about 80% of the Francis family's total income is off-farm, none of this has been used to finance the improvements on the property and funds for this have come from the cattle enterprise.

Undulating sheep and cattle grazing country and a few scattered gum trees surround the property. Moffitts Farm has perennial pasture and a mix of tree species including remnant hawthorne hedges and pines, as well as the habitat shrubs and trees and forestry trees planted by Pat.



Habitat and riparian corridors surround the grazing paddocks.

The soil on Moffitts Farm is clay loam from a basalt parent material. The property is gently undulating, sloping down to a creek running east to west through the middle of the property. The creek does not flow in summer and autumn when rainfall is lower, but it is fed from a couple of springs.

The lack of trees and perennial vegetation in the catchment area threatens salinity problems. There are also a lot of property owners in the area from Melbourne who do not recognise weeds on their lifestyle blocks, making weed management an issue of concern in the area.

The Staff

Pat has a degree in agriculture and has been farming all his life as a sideline to being a journalist. Pat's career as an agricultural journalist has supplied him with many rural contacts and the opportunity to visit a lot of farms. The knowledge and experience he has gained from other farmers has been a great help and incentive in the development of his property.

Pat is a member of the Upper Bolinda Creek Land Management Group and is in the Corrangamite Farm Forestry Project, which is involved in extension and promotion of farm forestry in the region. Moffitts Farm is Cattlecare accredited, MSA licensed and a member of Land for Wildlife, a national program that promotes wildlife on farm.

The Environmental Management Program (EMP)

The EMP for Moffitts Farm is a simple system that helps Pat manage the property and assure him that what he is doing is working. The policy for the property is supported by a list of environmental management objectives that Pat has set himself. He has then developed a set of strategies to help him achieve these objectives.



Pat Francis with a stand of habitat trees

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

The strategies in the EMP address issues including:

- biodiversity
- water quality
- carbon sequestration
- greenhouse gas emission
- salinity
- pollution of soil, water and air.

The lack of perennial vegetation on the property was the key to many of the environmental issues on Moffitts Farm and Pat introduced a combination of strategies to address the problem. Pat recognised that grazing had far more impact than he'd given it credit for.

Pat introduced minimum tillage and cell grazing to encourage the development of deep-rooted perennial grasses and ensure complete ground cover on the farm. These strategies improved the condition of the soil by increasing organic matter and microorganisms and reducing soil compaction caused by vehicle movements. Water retention of the soil has improved and now more rainfall is kept and used in the root zone of the plants rather than moving into the watertable.



Cell-grazing pasture with the five-year-old forestry plantation in the background

Cell grazing has minimised the requirement for fertiliser, herbicide and animal health products. Pat no longer needs to drench the cattle and uses very little herbicide. Pat's biggest weed problem was spear thistles and now he is getting very little trouble with them. Weed control has reached the stage now where labour is used rather than chemicals, except for some spot-spraying of blackberry.

Cell-grazing is also much more energy efficient. Less pasture renovation is needed and fodder conservation and supplementary feeding are no longer required, saving considerable time and energy.

The cattle are grazing more evenly under the cell-grazing system, with no stock camps producing areas of concentrated nutrient. The pasture quality is much better from cell grazing and is more easily digestible, decreasing the level of methane produced by the cattle.

As the productivity of the pasture improved, Pat needed less land for grazing and was able to contribute more area to habitat and forestry. Pat has fenced off about 20% of the farm area for revegetation and landscape enhancement.



Lavender plot next to the three-year-old forestry plantation

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

The two blue gum forestry plantations are 5 and 3 years old. Whilst they are a long-term financial investment, they provide many environmental benefits now. Although blue gum is the main plantation species, a number of other forestry species are being trialed and are mixed in with the habitat trees.

Habitat trees and shrubs have been planted in fenced corridors. Wildlife is encouraged in these areas by maintaining fallen wood, not cutting the grass and the placement of hollow logs for habitat. The trees not only provide habitat for native birds and animals; they also help hold rainfall in the root zone, sequester carbon and provide weather (in particular wind) protection for the cattle and pasture.

All of the riparian areas on the property has been fenced off so cattle cannot access them. Pat has put 10 dams on the farm as an alternative water supply for the stock. Only enough water is harvested on the property to maintain the cattle and for domestic purposes, with the runoff entering the creek for environmental flow. For weed control around the creek an appropriate chemical is used that will do no damage to the riparian zone.

Pat's environmental conscience has led him to minimise packaging by bulk purchasing, refilling and recycling where possible. He even puts his silage wrap through the wool press, for storage on farm until a recycling opportunity arises, rather than taking it to land fill.

Solar power is used for the electric fence and in the future will also be used for domestic purposes. Homegrown timber is used for fencing and firewood and in the future will be used for building on the property.

Monitoring

All these strategies are helping Pat and Anne to manage the environmental issues on the farm. They know this because they are monitoring and recording the results and reviewing them regularly. Pat says that monitoring provides reassurance that what they are doing is working and assurance that they are not doing anything wrong.

ITEM	HOW OFTEN
Soil nutrient test	Every 4 years
Water quality: invertebrate survey	Every 2 years
Bird survey (biodiversity)	Every 6 months
Soil organisms: survey for earthworms	Every 2 years
Chemical use	As remove from chemical store
Animal sightings (biodiversity)	Continual
Fossil fuel use	Continual, collated annually
Soil health/pasture quality (DSE/ha)	Continual

Schedule of monitoring activities



A habitat corridor dropping down to the riparian zone is fenced and planted with trees and shrubs.



One of the dams developed for stock to keep them out of the creek

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Pat is monitoring production and environmental performance, the combination indicating to him how the farm is doing. For instance, livestock productivity on a per-paddock basis is measured to ensure that positive changes in pasture composition and quality are being achieved. Cost of production for beef and non-grazed areas are calculated to monitor inputs being used. Other indicators that are regularly monitored can be seen in the schedule of monitoring activities.

Pat's focus on biodiversity has increased over time, with monitoring indicating more native animals on the farm. Seeing more kangaroos, echidnas and other species on the farm has encouraged Pat to expand the habitat development. There used to be koalas in the area and platypus in the creek and it is hoped that with provision of habitat and time these species will return.

Benefits and Costs

Moffitts Farm is a lifestyle farm and as such, does not provide enough income for the Francis family to live off. Therefore, they are dependent on off-farm income. The family invests more time into the farm, rather than money. They have been encouraged to do this because they see how much better the farm is getting. The environmental indicators show that the land is improving and it is more aesthetically pleasing now. The land value is increasing accordingly, helped by its being a lifestyle-sized farm close to Melbourne.

Pat has calculated a total cost of about \$500/ha for ownership and management of land in farm forestry, riparian zones and revegetation areas. This includes the cost of land ownership, rates, interest, development and maintenance. Costs of the changes on-farm have included \$10,000 on developing the stock dams, \$16,000 for fencing and \$1200 on a slasher to help reduce herbicide use. Farm insurance premiums are higher now because there is more fencing on the property. A slight disadvantage with the fenced-off habitat and forestry areas is the increased risk of weeds in these areas and whilst there has not been a problem yet, the habitat areas can harbour feral animals like rabbits.

The cost of monitoring can be high for a small enterprise like Moffitts Farm and Pat says he would probably do soil testing more regularly if it were not so expensive. However, the costs and disadvantages are far outweighed by the benefits seen both environmentally and in productivity of the farm. As Pat says *"We have developed a system that requires less input, is run at a lower cost and is more compatible with the environment. The resource base on Moffitts Farm is vastly better; all the indicators are improving."*

The perennial pasture and cell grazing have improved the soil condition, water retention and pasture productivity. Pat has been able to increase his stocking rate, is no longer dependent on fodder conservation, is self reliant for water and is not as 'at risk' from drought as he was. The cost of production has dropped from about \$1/kg liveweight initially to 80c/kg liveweight in 1999 and Pat expects he will reduce this further to 60c/kg liveweight this year.



Fencing of revegetation areas has been one of the main costs.

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

The forestry has both a financial and environmental benefit. Not only will it provide income in the long-term, it is currently habitat for native animals and provides weather protection for the stock and pasture. With carbon trading down the track, the forestry plantation will be even more beneficial.

Landcare and neighbours visit and call quite a lot to get advice. People are quite interested in what Pat is doing and so he has much more communication with others, which has been good.

Pat and Anne feel really good about what they are doing. They feel they are doing the right thing and get a lot of satisfaction from what they have achieved. Pat says *“We like to see the improvement in biodiversity and appreciate the environment a lot more now that we can see what we were missing. You don’t know what you are missing until you get it back, like the birds, frogs and other wildlife that have returned to our farm. We got a lot more than we expected with the increase in biodiversity and the farm looks a lot nicer than it did.”*

Having the EMP in place has given Pat greater confidence and peace of mind in his management of Moffitts Farm and less time is needed to fix problems on the farm. This is a great benefit to the Francis family because they live and work off-farm, so must commute to the property to do any work on the farm.

Pat believes the greatest benefit of having an EMP in place is that they have the records, monitoring and assessment in place so they can see where their money goes and how effective it is.

The Future

Pat and Anne have gone a long way to achieving their goals, but they still have more they want to do. Pat recognises that many of the environmental objectives they have set themselves will be achievable only in the long-term. He will not see the native animals he is encouraging back onto the farm until the trees are older and bigger and the riparian zone is healthier.

In the future Pat wants to reduce his impact on the environment further and reduce energy usage. Pat does not see the cattle staying on the farm in the future because it is not big enough to remain competitive. He will move more into conservation and farm forestry and investigate high value niche enterprises requiring small areas of land like grapes, lavender or olives.

Pat’s motivation for change came from seeing what others had experienced. Once he tried it he saw the benefits and was further motivated. His experience with EMP is that it need not be prescriptive or difficult, its basis is continual improvement. *“It is simple to get a system started and keep building on it”*. Pat recommends that others improve their environmental management and habitat on farm. *“Once you get started, you are sure to appreciate all the benefits and want to do more to improve your farm environment.”*



Fallen wood is maintained and new forestry trees developed for the future.

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Authors:
Suzanne Robinson
and Genevieve Carruthers



Witten Holdings is located in Victoria's Goulburn Valley.



Dairy cows grazing irrigated pasture



Runoff from the property drains into the Mosquito Depression water storage and reuse area.

Witten Holdings

Irrigated dairy farming – Improving the resource base and sustainability

Peter and Janelle Witten

Witten Holdings is a flood-irrigated dairy farm located in the Goulburn Valley near Tatura in Victoria. The farm is managed primarily by Peter Witten, with help from his wife Janelle and father Geoff.

The property demonstrates practical solutions to some of the environmental problems that face today's farmers. The issues facing the Wittens include salinity, dairy effluent management and limited water allocation.

To help them address the issues facing the farm, the Wittens have developed a business plan. In the plan, the family has identified the environment, production, maintenance and management goals for the farm. Implementation strategies and achievement measures are also documented so the Wittens know where their time, money and energies are going. The Wittens have developed a mission statement for their farm business, which states:

"Our mission is to engage in profitable, productive dairying with a sustainable future – endeavouring to leave our farm in a better condition than we inherited – remembering that we are only caretakers of the land."

Witten Holdings has developed into a model enterprise for the dairy and irrigated farming industry. Peter is the recipient of a Landcare award and has held Landcare and resource department field days on the farm. In addition, there has been plenty of interest from neighbours keen to see how the environmental management program works.

The Property

Witten Holdings is a 260 ha property consisting of two 130 ha farms, Oakridge and Oakridge Park. Peter's parents, Geoff and Barb, purchased the family's first property, Nangoony, in 1951. They then acquired the adjoining grazing property Oakridge, in 1963. Peter and Janelle purchased Oakridge Park, an adjacent horse stud, in 1979 and from that time the farm has been managed as one enterprise. Nangoony was sold in 1980 to finance farm improvements and a whole-farm survey was done. The dairy enterprise was started in 1982 after a property plan was developed and the farm restructured, based on soil types, drainage and irrigation.

The Wittens have 440 dairy cows and also rear calves and yearlings. The property includes a rotary dairy, two homes, two workers' cottages and assorted storage sheds.

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

The grazing pastures on the property include 130 ha of irrigated pasture, 28 ha of irrigated subterranean clover pasture and 160 ha of dryland pasture. Water storage and surrounding trees account for about 20 ha, tree plantation areas cover 20 ha and buildings, laneways, irrigation channels, hay storage, calving pads and other infrastructure incorporate another 20 ha of the property.

The soil on the property is loam on top of a clay base. The land is flat and has been laser levelled for irrigation purposes. Witten Holdings is primarily grazing pasture, with river red, flooded and spotted gums and some prickly paperbarks, *Casuarina* and ironbarks. The land surrounding the farm is flat, open grazing land with scattered trees.

Water for the property comes from two bores and the Goulburn Murray Water Arterial Channel, which is managed by the Goulburn Murray Water Irrigation Authority. There are a number of irrigation channels on the farm. The only natural watercourse on the farm is the Mosquito Depression, which only flows in winter and drains into the Goulburn Murray Water Arterial Drain. The Depression provides in-line water storage for Witten Holdings to keep water for summer and it drains naturally in winter.

The property is located in a region where salinity is a big problem and many of the management strategies on the farm have been initiated to tackle this issue. The management of other farms in the district can have a substantial affect on the farm. Likewise, the management of Witten Holdings can impact on the catchment. The Wittens must therefore manage the irrigation on the property carefully, considering the quality of both the channel and groundwater when making irrigation decisions.

The effluent produced by the dairy is another key consideration for the Wittens and they have developed an effluent management system that ensures the property benefits from the fertiliser and soil conditioning qualities of the effluent and that no nutrient leaves the farm to enter the waterways.

The Staff

Peter has been farming for over 25 years and has a Diploma in Farm Management. Janelle has tertiary level finance training and both Peter and Janelle have done a farm business course through a Rural Finance sponsored program. Peter is on the customer committee of the Goulburn Murray Water Irrigation Authority and is also a member of the Dhurringile Landcare Group. He is involved in industry discussion groups and in the planning of Murray Dairying project funding allocation. He has also contributed to committees of the Dairy Research and Development Corporation. The farm employs a full-time staff member who has a dairy apprenticeship and two relief milkers.



The channel that supplies irrigation water to Witten Holdings



Mosquito Depression water storage and reuse wetland area

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings



Irrigation channel used for flood irrigation of pasture

The Environmental Management Program (EMP)

Peter rates the water table, water use and soil degradation as the priority issues for Witten Holdings. The salinity issue in the area has stimulated a lot of work on drainage and good irrigation practice. The property's low water allocation made the Wittens realise the value of the water resource and they have developed systems for water capture and recycling.

The paddocks have been laser levelled to optimise water use. The channels, lanes and drainage lines on the farm have been developed around the Mosquito Depression, with all drainage water ending up in this storage wetland reuse system, which holds about 50ML of water. Trees have been planted around the depression and the area has been fenced off to become a wetland environment for wildlife. Nesting boxes have been attached to trees in the area and Peter intends to provide more nesting grounds for wildlife on the property.



Nesting boxes are attached to some of the trees for wildlife on the farm.

In excess of 30,000 trees have been planted on the farm, with more planting planned for the future. This habitat creation has resulted in a substantial increase in biodiversity on the property. The trees are also helping control the rising water table.

The water table is a problem and the salinity level of the groundwater is high, up to 4000 EC. Since Peter doesn't like using anything over 1000 EC for irrigation, he has to shandy the groundwater with channel water when he uses it to irrigate the pastures.

Another water management strategy on the farm has been to convert from dams to troughs for watering the cows. All the old dams have been banked to dry out. Peter has trialed aquaculture in one of the dams near the dairy shed, but has not yet taken it any further.



Dairy effluent is captured and stored in an effluent pond.

The effluent from the dairy shed is captured in an effluent dam and is pumped out when needed and spread on the pasture. A nutrient balance based on effluent, soil and tissue testing ensures that the soil is not being overloaded with nutrient. Any runoff from the paddocks is captured in the Mosquito Depression system which removes any nutrients present in the water.

The structure and condition of the soil have been improved by using minimum-tillage practices, oversowing pasture and using dairy effluent on the pastures.

Chemical usage is much less than it was. Peter does not spray pastures for insect pests any more and only uses weed spray in the irrigation channels when they are dry.

Case studies

- Bally Glunin
- Moffitts Farm
- Pacific Coast Bananas
- Witten Holdings

Monitoring

Monitoring is an important component of the environmental management program, as it allows the Wittens to track their progress all the time. Monitoring results have a dramatic impact on issues such as fertiliser and groundwater use. The environmental indicators that are measured on Witten holdings can be seen in the table below.

ITEM	HOW OFTEN
Soil nutrient test	Annually
Pasture tissue test	Every 2 years
Groundwater EC levels (salinity)	Every time pump is used (about every 9 days in summer)
Recycled water EC	3 – 4 times over summer
Water table (test wells)	Twice a year, in summer
Dairy effluent nutrient levels	Once a year
Birdlife survey	Continual

Schedule of monitoring activities

The management system is reviewed annually and management decisions and changes to the system made accordingly.

Benefits and Costs

The Wittens are sure that the changes they have made are having a positive environmental effect and the management approach they have in place is helping assure them of this. The EMP gives Peter greater confidence in the management of the farm and he has found that he has fewer problems on the farm with the system in place.

The health of the soil has improved and the land is more productive as a result, allowing increased stocking rates on the farm. Fertiliser costs are reduced by up to \$10,000 with the use of the dairy effluent.

The water storage wetland and reuse system on the property saves on water requirements, so the farm can make do with its current water licence. Peter estimates that the savings from the water recycling system alone are at least \$6000 a year, which is what it would cost him to buy the 200 megalitres that are currently recycled. This figure reflects costs if the water were purchased on the temporary market. However, cost savings from water recycling are actually much higher if trading water on the permanent market; at about \$700 per megalitre, it amounts to \$140,000 saved. The storage wetland also captures nutrient runoff and has become a habitat for wildlife.

Peter and his family have received a lot of personal satisfaction from seeing the changes to the farm. They feel they are doing the right thing environmentally and the community obviously supports this, with Witten Holdings winning the Goulburn



Dairy effluent spreader used on pastures



Irrigation channels are only sprayed for weed control when dry.



Test well for monitoring the water table

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Broken Catchment Landcare Award in 1998/1999. The improved community relations and industry image have come as a pleasant surprise to Peter.

The cost associated with the changes on the farm has been \$500,000 or more over the last 20 years, with the majority of the cost being for infrastructure and capital equipment. The trees on the farm have cost about \$15,000 to buy as tubestock, with planting and fencing additional. Soil tests are about \$600 a year.



The water storage and reuse system has saved on water costs, is a nutrient trap and provides a wetland habitat for wildlife.

The Future

Peter is happy with how well the development of the farm has gone and is pleased with the results so far. The work on the farm is ongoing and is not complete. There is still about 20% of the planned work left to be done.

Peter has been able to focus on the environment more as the production aspects for the farm have been organised and thinks the focus in this area will increase. Peter plans on encouraging more biodiversity on the farm through expansion of tree planting and development of another water storage wetland.

Unfortunately, drought and the downturn in the dairy industry have meant that progression has been slower over the last few years than Peter would have liked, but he is

committed to seeing the plans for the farm through, even if they do take a little more time than originally anticipated. The Wittens have survived tough times before and making it through those rough patches gives them confidence they can do it again if need be. They see a great future for themselves in the dairy industry and are active in investing time and money in environmental management to further assure that future.

The issue of the rising water table and salinity is a concern to Peter. Both issues are hard to stop and take years to reverse. Peter is doing everything he can to ensure the sustainability of the farm and will continue to address salinity and land and soil degradation on farm. But it isn't just what Peter does that affects the property; everyone else's management in the catchment affects it also, so he is dependent on others in the area to farm sustainably as well.

The Witten family has been proving its commitment to a sustainable dairy industry for twenty years and intends continuing that commitment to environmental stewardship. Peter believes that environmental responsibility is essential to a future in farming and encourages others to take action to ensure an environmentally sustainable future for their farm.

Case studies – Victoria

- Bally Glunin
- Moffitts Farm
- Witten Holdings

Southcorp

The Australian wine industry looking after the environment

Nick Gill and Peter Ashby

Southcorp is Australia's largest producer and exporter of high quality wines. Penfolds, Lindemans and Seppelt are just some of the brands for which the company is well known.

Southcorp has recognised that if the Australian wine industry is to remain profitable and sustainable it must adopt strategies that protect and enhance the environment both now and in the future. Southcorp's environmental policy is:



The Kaiser Stuhl chateau, site of Southcorp's headquarters in the Barossa Valley

"To minimise any effect our activities may have on the environment and to ensure that the well being of our employees and the community is protected."

To achieve this goal, Southcorp has developed SILCS (Southcorp Integrated Loss Control System). SILCS is an integrated risk management system that considers:

- occupational health and safety
- product quality and safety
- environmental impact.

SILCS can be applied to any situation and decisions are based on whether or not they will have a negative impact on the health and safety of Southcorp's employees, the safety and quality of the grapes or the overall health of the environment and community at large. The process closely reflects the EMS process outlined in ISO 14001, although Southcorp does not intend to pursue certification to that Standard at present.

All of Southcorp's vineyards are either using SILCS or are in the process of adopting SILCS. One of these vineyards is the Walton's vineyard at Seppeltsfield in South Australia, in the heart of the Barossa Valley.

The Barossa Valley has been home to the Australian wine industry since German immigrants first moved into the area and established vineyards and wineries in the mid 1800s.

The Property

Southcorp established Walton's vineyard in 1998 on what was traditionally grazing land. There are still some sheep agisted on the property, but they are not allowed on the creek areas, which are considered 'sensitive'. Developments on the site were done according to land capability.

Authors:
Gioia Small and
Genevieve Carruthers



Map of South Australia showing the location of the Barossa Valley



Seppeltsfield is in the heart of the Barossa Valley.



Case studies – South Australia

- Southcorp
- Yalumba Wines
- Stehr Group
- Ingerson Citrus



Some of the remnant vegetation that has been retained at Walton's vineyard

The vineyard makes up 120 ha of a 370 ha site. A further 80 ha may be developed in the future to take the total vineyard development to 200 hectares. This represents an investment of millions of dollars in this vineyard alone.

The soils on the property are predominantly red brown earths (lithosols). There are scattered pockets of *Casuarina* and *Calytris* on the hilltops. Two hectares of mixed endemic species and *Casuarina* have been planted as windbreaks throughout the vineyard. Greenock Creek runs through the Walton's vineyard so Southcorp must ensure that its vineyard activities do not impact negatively on the health of the creek system.

A 200 ML dam has been constructed on the site, to provide the vineyard with its water requirements. The dam has been fully lined to ensure that no water is leached into the immediate environment. There are also several smaller non-supply dams on the site.

The Staff

The Site Manager at Walton's vineyard is Nick Gill. Nick has worked in farming all his life. Born on a grain farm, Nick went on to do an honours degree in Farm Dryland Systems at Roseworthy College and in 1996 joined Southcorp. Since that time he has held a wide variety of roles and in the last couple of years has been responsible for the development of the Walton's vineyard. Nick is a member of the local Agbureau.

Nick is responsible for a wide range of staff, including technical and production personnel. Many of the staff have tertiary qualifications in viticulture, whilst others have numerous years of experience behind them.

The Environmental Management System (EMS)

Much of the wine from Southcorp is sold internationally. *"There has been a significant paradigm shift in the community generally and Southcorp wants to be seen as doing the right thing in the environment"*, says Nick. *"There is a lot more community awareness of what is happening in the environment"*. This paradigm shift has been one of the major drivers for the development of the EMS. Nick says that markets are currently demanding mostly quality standards, but that there is an emerging trend for accountability in environmental matters. *"The European and UK markets ask questions of the exporter about their production practices."* An emerging area of concern amongst foreign markets is the use of child labour.

The main environmental issues for the Walton's vineyard are:

- soil conservation
- surface water management
- conservation of remnant vegetation
- chemical use efficiency
- biodiversity
- prevention of contamination of the environment.

Case studies – South Australia

- Southcorp
- Yalumba Wines
- Stehr Group
- Ingerson Citrus

Southcorp have developed a checklist of features to be considered during vineyard establishment but, at present, this checklist is not available outside the company. They also utilised the knowledge of local farmers and a range of consultants, catchment planning and whole-farm planning groups when developing the Waltons Vineyard.

Soil conservation is very important for the Walton's vineyard. Many properties in the Barossa Valley still utilise clean cultivation between the vine rows.

If soil is not managed properly at the Walton's vineyard, there is a risk of erosion and run-off into the creek. Walton's vineyard has adopted the use of inter-row cover crops to minimise this risk. Run-off, sedimentation and dust storms arising from soil erosion from surroundings properties can sometimes affect Walton's Vineyard.

The photograph at right highlights what can happen if soils are not managed correctly. The Walton's vineyard is now undertaking remedial strategies to correct the erosion that has occurred on the property due to past practices.



Erosion can occur when soils are not managed correctly.

Water management is considered critical to grape growing and the vineyard has been developed with an irrigation system that matches the soil type. This means that Nick and his staff apply the exact amount of water that grapes require to produce a high-quality product without any excess water leaving the property. This minimises the risk of contamination of the Greenock creek system through water run-off.

Large headlands have also been developed around vines close to the creek system to provide a buffer zone for this fragile riparian environment.

Water is a key issue for the Barossa Valley and Southcorp employs irrigation strategies to minimise consumption of this very valuable resource. All the development that took place at Walton's was based on soil surveys. This information helped design the irrigation system as well as identify areas that were not suitable for grape growing.

When Southcorp developed the Walton's vineyard, remnant pockets of vegetation were retained to ensure that native flora and fauna were not eradicated from the area. Birds can cause considerable problems in vineyards because of their liking for sweet grapes and many vineyard developments remove all trees for this very reason. Care has been taken that this is not the case in the Waltons Vineyard.

Southcorp's approach is to maintain and enhance native vegetation and find alternative methods of bird control. This can include the use of bird scarer kites.

Nick is committed to becoming more efficient in chemical use so that the risk of environmental contamination is reduced. Strategies that have been implemented

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include pest and disease monitoring. This ensures that sprays are applied only when the economic threshold of pest and disease damage has been reached and not at the first sign of a problem.

Monitoring

Monitoring is a very important part of the EMS and Nick and his team have benchmarked a range of environmental indicators, so that they understand the status of the environment from the very beginning.

In the future, Nick and his team will be monitoring a range of issues to make sure that they understand what is happening in the vineyard and its surrounding environment.

ITEM	HOW OFTEN
Soil (including organic matter)	Once every 2 years
Water quality	Test wells will be sampled annually
Vegetation surveys	Under development
Bird life surveys	Under development
Community relations	Feedback from neighbours will be assessed annually

Proposed monitoring activities

Annual reviews of all monitoring data will be conducted. Monitoring data will be fed back into management decisions on an on-going basis.

All farm records are computerised and information is gathered on each block. The custom designed program (called Admar) allows management to identify production and profitability on a block-by-block basis.

Benefits and Costs

Nick believes in the importance of good community relationships and has struck up good relationships with other local farmers. Nick often attends local farmer group meetings to communicate what he is doing in and around the vineyard.

The Walton’s vineyard was established with the environment in mind. Using SILCS, Nick and his team were able to analyse what impact their activities were going to have on the environment.

Within the workforce there is recognition that they are “doing the right thing”. Nick believes that his employees take pride in being environmentally aware.

There were extra costs associated with being more ‘green’. For example, there were extra costs associated with designing blocks based on soil type.

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Generally, vineyard blocks are regular shapes; however, many of the blocks at Walton's are irregular because of different soil types. Consequently many more strainers had to be installed to accommodate this different approach.

The use of buffer zones around the headlands near the creek meant that land that may have traditionally been utilised for grape growing was not available for that use.

According to Nick, these extra costs are not huge when you consider the overall cost of the development and therefore they can easily be absorbed.

In the future, more money will need to be spent on pest and disease monitoring. However, the savings in chemicals and in the time involved in applying those chemicals should more than compensate for the monitoring cost.

The major benefit of the approach adopted by Southcorp is that they face the future knowing that they have a sustainable vineyard management scheme in place. Southcorp will also be able to demonstrate to its customers that it is producing grapes and wine with due care for the environment.



Diagram showing buffer zone adjacent to Greenock Creek

The Future

Southcorp has been an active participant in environmental issues. It is a signatory to the national Packaging Covenant; a framework for life cycle management of packaging products and sponsor of the Australian Conservation Foundation supporting research and development in relation to land and water management.

In the future, Southcorp will address an expanded range of environmental issues. These potentially will include efficient use of electricity, tree planting, reduction of evaporation from dams, overall production efficiency, reducing reliance on chemicals and a greater focus on pest and disease monitoring.

According to Graham Kraehe, Southcorp's Chief Executive Officer, the whole of the Australian wine industry must take an active role in creating an industry-wide system of standards development for environmental management. Nick also believes that the industry as a whole should be providing information to farmers to enable them to make sustainable choices for farm management.

Southcorp has clearly taken a lead in the area of environmental management. They believe that the audit and monitoring trail that they are able to provide is an important feature in being able to demonstrate their responsible environmental management. The future will see many other wine companies and winegrape growers recognising and adopting environmental management as a natural part of their management ethos.



An example of an irregular shaped block

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Authors:
Gioia Small and
Genevieve Carruthers

Yalumba Wines

Improving and caring for the environment: a family winery approach

Cecil Camilleri



Map of South Australia showing the location of some of Yalumba's vineyards

The story of Yalumba, which was established by Samuel Smith in 1849, spans six generations of Australian history, making it the oldest family-owned winery in Australia.

The company is a grower and producer of distinctive wines, marketing in Australia and internationally through its sister company Negotiants International. The latter has created one of the world's finest portfolios of wines, which are now exported from Australia to over 30 countries.

Yalumba has built its reputation on handcrafting fine wines that reflect a commitment to showcase regional character, distinctive varietal flavour and individual personality. The grapes are sourced from its vineyards in Coonawarra, Wrattenbully, Oxford Landing, the Barossa Valley and Eden Valley.



The Yalumba winery in the Barossa Valley

Yalumba recognises the importance of the environment in its day-to-day business activities and it has made a strong commitment to the environment by:

- introducing a waste minimisation and pollution strategy
- developing an environment improvement program
- implementing a heritage conservation strategy.

Yalumba was the first wine company to participate in the Greenhouse Challenge scheme - a voluntary group of commercial organisations committed to estimating and reducing their greenhouse gas emissions.

The company is also an active member of the Environmental Committee of the South Australian Wine and Brandy

Association - a committee charged with developing the Australian wine industry's first strategic plan for the environment.

The Properties

Yalumba's vineyards occupy an area of some 720 hectares and span a wide geographic area. Some of the vineyards are close to significant drainage systems and the Heggies vineyard in the Adelaide Hills adjoins the Kaiser Stuhl Conservation Park. It is therefore imperative for Yalumba to have sound plans in place to ensure that they have a minimal impact on the environment.

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The Staff

To help facilitate the adoption of its EMS and all the associated activities, Yalumba has appointed Cecil Camilleri as its Technical Manager for Environmental Matters. Cecil has guided and coordinated the EMS at Yalumba for the last two years. Cecil has a Bachelor of Science degree, a Masters of Agricultural Economics and is currently completing a PhD on vineyard ecosystems. He has a broad background in agriculture and economics and for the past few years has been studying vineyard ecosystems; so Cecil is well placed to understand the production, economic and environmental implications of any decisions that are made.

The Environmental Management System (EMS)

Yalumba has adopted a philosophy of continuous improvement in all its activities and the company's environmental policy is:

“...to integrate environmental objectives into relevant business decisions in a cost-efficient manner and address environmental responsibilities as part of the normal operating procedures.”

To achieve this goal, Yalumba is using the environmental standard ISO 14001 as a model for developing its Environmental Management System (EMS). While there are no plans to seek certification for their EMS, this may change in the future. Yalumba already implement ISO 9002 for their packaging and labelling line and are developing HACCP plans in collaboration with the Australian Wine Research Institute. The integration of QA, OHS and EMS offers substantial benefits in the integration of management functions and teams.

The environmental issues for Yalumba's vineyards vary according to their location; however, all vineyard managers consider the following environmental issues as part of their day-to-day management:

- biodiversity
- pests and diseases
- agricultural chemicals
- soils
- nutrients
- irrigation
- noise
- energy conservation
- waste.

Vineyard managers complete an environmental impact assessment for the vineyard under their control. If an impact is found to be significant, remedial actions to address

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the problem and a timeframe to do so are established. A proforma assessment process has been developed which addresses air, soil, water, landscape and stakeholder issues to be considered.

The vineyard managers use a reporting protocol that addresses the details of the best management practices employed in these areas. As part of their continuous improvement program, the vineyard managers score their achievements in the areas of environmental management.

An example of best practice biodiversity management is the establishment of inter-row cover crops. Having a biologically diverse vineyard floor promotes a range of beneficial insects and potentially reduces the need for pesticides.

A vineyard that has not implemented the use of cover crops is considered to be at the very early stages of biodiversity management and would need to take appropriate measures.

This method allows the vineyard manager to identify where he/she needs to put time and energy to achieve best practice. In essence, the vineyard manager is doing an audit of current best management practices.

A similar approach is adopted by all of Yalumba's operations, including the winery and administration areas. An environmental protection checklist guides Yalumba's staff and helps them identify areas where improvements can be made.

Areas that are considered include:

- recycling in the office
- waste storage and treatment
- effluent management and disposal.

The management and disposal of winery effluent in an environmentally responsible manner is essential. Not surprisingly, the suitability of land for irrigation with treated winery effluent is critical. Factors that are taken into consideration include soil type, infiltration rate and other risks associated with waterlogging, structural loss and erosion.

Another very important part of Yalumba's EMS is their emergency preparedness and response procedures. Whilst every effort is made to ensure that environmentally adverse events do not occur, a backup system of procedures is in place to respond to accidents and emergency situations. This includes documenting the situation and the corrective action taken.

To ensure that its EMS is working, Yalumba periodically reviews the entire EMS ensuring that the records the company keeps are relevant and procedures are being



Yalumba's Heggies Vineyard in the Adelaide Hills

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adhered to. Any changes to legislation are also considered and, if necessary, integrated into the EMS. At this time, changes to the company’s environmental policy and environmental objectives can also be made.

Monitoring

Appropriate monitoring techniques are used to ensure that significant environmental impacts are avoided. Soil and wastewater samples are taken at regular intervals throughout the year.

Tests on wastewater include pH, electrical conductivity, suspended solids, biological oxygen demand, and a range of nutrient levels. The frequency of these tests depends on the time of year and the activities under way at the winery.

PERIOD	HOW OFTEN
Pre vintage	Fortnightly
Early vintage	Weekly
Peak vintage	Weekly
Late vintage	Weekly
Post vintage	Fortnightly
Non vintage	Every 6-8 weeks

Sampling frequency for effluent water from the winery

Management level records are kept on computer, with programs Filemaker Pro (for risk analysis), Excel and Word being used.

Benefits and Costs

The EMS adopted by Yalumba is still in its early stages, however, a number of significant benefits are evident. The environmental audits undertaken within the vineyards, winery and offices provide Yalumba with the opportunity to identify savings in resource use.

The checklist that vineyard managers use to determine their level of best practice management highlights deficiencies and allows for improvements to be made to natural resources.

Establishing clear documented procedures for winery operations such as effluent disposal ensures that the risk of an accident resulting in environmental damage is reduced. Liabilities and risks are reduced as part of the EMS process. Yalumba now pays lower insurance premiums in recognition of its reduced risk status.

Yalumba is negotiating reduced licence fees with the EPA. It is now easier for them to meet legislated requirements and licence requirements.



The Cooperage at Yalumba

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Naturally, changes in management do not often occur without cost. The development of the EMS at Yalumba has required substantial commitment. The appointment of a Technical Manager for Environmental Matters reflects that high degree of commitment. Cecil's salary is a cost directly attributable to the EMS development. However, it is much more difficult to separate out other costs, as management is an integrated process. The immaturity of the system so far is another factor in making costs difficult to determine.

The Future

Yalumba believes that the environment plays an important part in all their management decisions and a lack of environmental commitment now may result in limited access to markets in the future. In particular, the 'clean green' image that Australian wine now holds overseas may be challenged in the future, if there are no documented systems to back up such claims. Yalumba see their EMS as the way to provide such proof. Yalumba have developed a range of brochures promoting their environmental work.

According to Cecil Camilleri, consumers will continue to demand 'clean, green' products and they will probably start to demand empirical evidence to justify this claim.

Yalumba believes that in the future, environmental management will be taken for granted and fully integrated into the business culture of every company.

The Australian wine industry, in its strategic plan 'Strategy 2025', clearly identified that future consumers of Australian wine will want a product that is environmentally friendly, healthy and natural. Yalumba's adoption of an EMS means that it is well placed to deliver the style of product the consumer is looking for. This will ensure Yalumba's continued success in the marketplace.

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Stehr Group

Farming fish in an environmentally sensitive way

Trenton Hadie

The Australian aquaculture industry is rapidly emerging as an industry that has great potential for growth. Australian fisheries production is estimated to have an output valued at around \$500 million and aquaculture contributes to over a quarter of this production.

The industry's vision is:

"By 2010 a vibrant and rapidly growing Australian aquaculture industry will achieve \$2.5 billion in annual sales by being the world's most efficient aquaculture producer."

The Stehr Group of companies, located at Port Lincoln on the Eyre Peninsula in South Australia is part of this industry.

Tuna fishing in Port Lincoln started back in the 1950s and today Port Lincoln is considered the tuna capital of Australia. The industry has had its share of ups and downs since its establishment because of poor weather conditions, government quotas and lack of marketing expertise. Today, the industry focuses on supplying the requirements of the exacting Japanese market.

To be able to meet the expectations of the Japanese market and to provide its customers with the confidence that the fish they buy have been produced with great care for the environment, the Stehr Group has adopted ISO 14001 as its environmental management system (EMS).

The Fish Farm

Australian Tuna Fisheries, a company owned by the Stehr Group was established in 1995 by Hagen Stehr. The company farms tuna, as well as operating fish hatcheries, producing yellow tail, kingfish and snapper. Tuna, however, is the company's major source of income and Australian Tuna Fisheries exports all of its tuna to Japan.

The fishing operation usually starts in December and goes on into January. Spotter planes are sent out to sea to locate large schools of tuna. Once these schools are located, the fishing vessel makes its way to the tuna.

The fishing vessel catches the tuna by enclosing the tuna within walls of netting. A line is then pulled that closes the bottom of the net and prevents the tuna from escaping.

The tuna are then towed back closer to shore in floating cages. The towing operation can take anywhere between two and six weeks, depending on the weather.

Authors:
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Genevieve Carruthers



Map of South Australia showing the location of Port Lincoln



Staff at the factory getting lines ready for the coming season

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Once the tuna have been towed back, they are kept in large fish cages and fed daily until they are fattened to the required weight. Generally, the tuna are sold from May through to August each year and in the time they are kept in the cages they put on around 12 kg of weight. The fish are marketed when they reach about 30 kg and attract very high prices. One fish alone can be worth \$3000.



A fish cage used for farming tuna

When the fish are ready to be sold, divers enter the fish cages and hand harvest the fish. The fish are gilled and gutted on the boat and then transferred back to the factory where the tails and gill plates are removed and the fish snap-frozen to -60°C . The tuna is then ready for export.

The Staff

The management and staff at the Stehr Group have many years of practical experience in fish farming. Trenton Hadie is the farm manager and is responsible for the day-to-day operations of the farm. With a background in marine biology, Trenton understands the impact that fish farming can have on the marine environment.

As part of its commitment to ISO 14001, the Stehr Group has implemented a training program for its staff, to ensure that all of the staff are familiar with the environmental commitment the company has made.

The Environmental Management System (EMS)

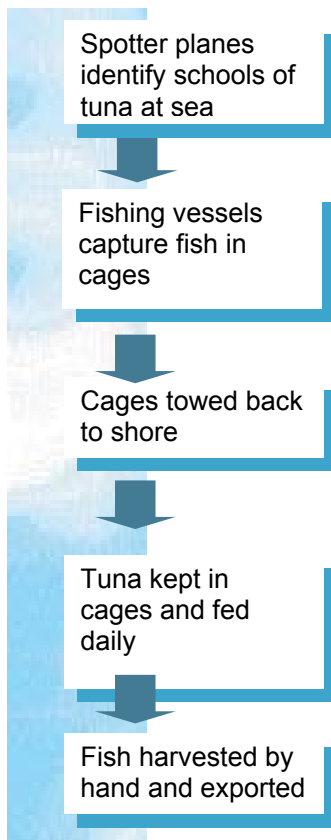
The environmental issues facing the aquaculture industry are unique. In the marine environment, fish farming and its associated activities have the potential to cause a lot of damage if not managed correctly.

The main environmental issues for the Stehr Group include:

- waste control
- overfeeding of fish
- fishing vessel spills
- fish processing.

The fish harvesting operation involves the removal of gills and guts whilst the harvesting vessels are still offshore. The resultant waste needs to be managed carefully at sea. On shore, waste needs to be disposed of in an environmentally sensitive manner. The Stehr Group is currently exploring opportunities to have the fish waste recycled into plant nutrient products.

Getting the right amount of feed to the tuna in cages is critical to the health of the marine environment. If there is excess feed, it can sink to the ocean floor and produce anoxic gases that will cause fish death. The sediment can also resuspend in the ocean water and fish death can occur due to lack of oxygen.



The main steps in tuna fish farming

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Oil and fuel spills also have the potential to cause hazards to the environment, so the Stehr Group has invested in spill kits. Should an accident occur, they are well prepared to manage it.

The shed operations also had to change when the Stehr Group implemented their EMS program. When a fishing vessel returns to shore and offloads its cargo, the nets are taken to the processing shed and washed down to remove any waste.

To ensure that none of this waste fouls the environment, a bunded area with a water collection pond has been developed in front of the processing shed to allow nets to be washed down without any risk of run-off contaminating the environment. The run-off is either allowed to evaporate or disposed of in such a way that it does not harm the environment.

Monitoring

It is very important for the company to know exactly what is happening in the ocean water. To do this, the Stehr Group employs a strict regime of monitoring to ensure that they can continually manage their environment in a sustainable manner. Some of the monitoring activities that the Stehr Group performs as part of its EMS are shown below.

ITEM	HOW OFTEN
Oxygen levels	Daily
Water quality	Done at 5, 10 and 15 metres on a weekly basis
Sediment on the sea floor	Annually
Excess bait	Daily

Schedule of monitoring activities

Benefits and Costs

In the past, the tuna industry has suffered from a poor image because of environmental concerns about the industry’s activities. This poor image was compounded by the fact that the industry was perceived to be ignoring the public’s environmental concerns.

The Stehr Group is attempting to rectify this situation by putting in place an EMS that is of an international standard. The adoption of ISO 14001 reflects the Stehr Group’s commitment to be part of a tuna industry that is both economically and environmentally sustainable.

The changes that had to be made because of the EMS have not come about without costs. The Stehr Group employed a consultant to help guide them through the development of their EMS and there have been some administrative costs because of the records that must be kept.



The waste water collection pond



The wash down area in front of the processing shed

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There are also more costs for staff training and additional equipment had to be purchased to ensure that the monitoring activities required by the EMS could be undertaken (for example, underwater video camera equipment). Overall, Trenton estimates it has taken 18 months to fully develop and implement the system.

However, according to the Stehr Group, these changes not only make the company better able to manage its operational environment, they have also improved the quality of the tuna resulting in better profits.

The Stehr Group's monitoring activities mean that the water quality has improved, so there are fewer mortalities and less risk of disease because of better feed management.

The improved safety of their employees is also a benefit. The company now has documented Standard Operating Procedures for all the key tasks undertaken by staff. This means that all staff are very clear about what needs to be done in any situation and the potential environmental and safety impacts that might arise in an emergency.

Generally, there is greater confidence in management at the Stehr Group because the company knows it has identified the risks associated with its activities and has put in place programs to manage those risks. If the company strikes a problem, they have a contingency plan in place to take care of it.

The company has also benefited through public recognition of what they are trying to do and consequently community relationships have improved.

The Future

The management of the Stehr Group sees the company moving into a cycle of continuous improvement as they continually refine their EMS. Given the benefits that the company has already experienced, the future looks very bright.

Whilst market access for tuna farmers is not constrained by whether the farm has an EMS or not, the Stehr Group believes that their EMS will help them improve their market share in the future. The company knows that it can provide its customers with objective evidence of its commitment to environmental improvement. While the Stehr Group does not make use of its EMS in marketing yet, there are plans to do so in the future. The EMS has been audited by a third-party auditor in preparation for this.

The Stehr Group believes that the tuna industry should take responsibility for the environment it works in and that the industry should get behind an environmental standard that would apply to all tuna farmers.

Aquaculture is an industry where there is great opportunity for growth. If Australian aquaculture can develop and maintain a reputation as an industry that is environmentally responsible, its chances of achieving its target of \$2.5 billion in annual sales by 2010 will be greatly enhanced.

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Ingerson Citrus

Environmental stewardship and premium fruit production in the Riverland

David Ingerson

The Ingerson family grows premium quality citrus, apples, avocados and winegrapes in the Riverland region of South Australia. They have developed markets both in Australia and overseas and have adopted a holistic approach to their fresh produce production. The Ingerson family's vision is:

"To provide safe, quality produce by using world's best sustainable production practices."

Both David and Judy Ingerson are enthusiastic about conserving the environment for future generations and are actively involved in local community environmental associations and committees as well as being landpartners in the local Bookmark Biosphere reserve.

The Property

The Ingerson family currently owns and operates around 140 hectares of properties, including a fruit pack house, in the Riverland region of South Australia.

The Riverland is dubbed Australia's fruit bowl and the River Murray is the lifeblood of the area, providing irrigation water to horticultural properties throughout the region.

Six of the Ingerson properties are situated adjacent to the River Murray and its floodplains, and any horticultural inputs such as nutrients and irrigation can impact on the overall health of the river if not managed correctly. This makes it essential that the company acts with great care for the environment.

Threatened species along the River Murray include quail populations and Murray River tortoises. Feral animals such as foxes have been the main reason for the decline in numbers of tortoises in recent times.

In recognition of the need to preserve native vegetation and to encourage biodiversity within the region, the Ingerson family has set aside approximately 35 hectares of naturally vegetated country as a native fauna and flora refuge.

David and Judy have changed many management practices on their farm since they have taken over. Changes in varieties of citrus grown have occurred as a response to market signals. They have also developed policies on:

- land and water resource sustainability
- irrigation management
- soil management
- environmental safety

Authors:
Gioia Small and
Genevieve Carruthers



Map of South Australia showing the location of the Riverland

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- integrated pest management
- biological controls
- waste management
- natural resource management.



Promotional material used by the Ingersons

All of these policies ensure that the Ingersons carry out their horticultural production activities with minimal impact on their environment.

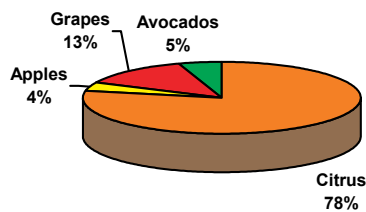
David believes in the importance of long-term planning as *“in the citrus industry you need to plan at least eight years ahead to make sure that you keep abreast with market requirements”*.

Both David and Judy agree that short-term production objectives should not compromise longer-term environmental objectives. *“In short, you need to balance what you are doing now with the impact that may have on the environment at a later date”*.

The Family

The Ingerson family settled in the Riverland in 1930 and began producing high-quality fruit for markets in Adelaide, Melbourne, New Zealand, Asia and Europe.

David and Judy Ingerson became directors of the horticultural operation in 1984 and their passion for environmental protection and sustainable horticultural production has led to many initiatives in horticultural management practices. These include the use of Integrated Pest Management in the orchards and the development of the ‘Insecticide Free Citrus’ marketing concept.



Breakup of income according to crop

David has been farming for forty years and during that time has done many courses in Business Management. Recently, the Ingersons adopted Quality Assurance for both the orchard and the pack house using the SQF 2000^{CM} approach.

The farm generates most of its income from citrus. The figure at left provides a breakup of the Ingerson’s production income.

The Environmental Management Program (EMP)

The main environmental issues for the Ingersons are:

- irrigation and drainage
- biodiversity
- native vegetation.

New plantings on the farm are always preceded by a soil survey. This information is used to design irrigation systems and ensures that only land that is capable of sustaining horticultural activities is developed. The Ingersons’ farm is close to the River Murray, so management of nutrients and irrigation water is critical. Irrigation,

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if not managed correctly, could result in the leaching of nutrients and salts into the river system, seriously affecting river health.

The Ingersons have adopted the use of foliar nutrient sprays to reduce the risk of leaching nutrients into the waterways. Low level sprinklers with low output application rates are used to conserve water—the Ingersons’ most precious resource; water. At each irrigation event, soil moisture is monitored to ensure that excess irrigation is not being applied.

Because monocultures such as orchards do not encourage a great deal of biodiversity, David and Judy have adopted the use of inter-row sowing with botanically diverse species to provide a habitat for beneficial insect populations. These beneficial insects predate on insect pests, thereby reducing the need for insecticides.

Inter-row ground covers also greatly benefit soil structure on the farm, by returning organic matter back into the soil. Additionally, David and Judy return all tree prunings to the soil by mulching on site. Any waste fruit from the pack house is also composted and incorporated back into the soil.

Other things the Ingersons do to be more environmentally friendly include buying fertiliser in bulk to minimise packaging and/or purchasing only returnable containers. They also stipulate that any packaging materials used in the pack house are made from recycled materials.

Monitoring

To ensure their EMP is working the Ingersons have a monitoring program in place. The table below lists some of the things the Ingersons monitor. The results of this monitoring are used to make management decisions on farm.

For example, monitoring soil moisture means that the Ingersons can decide exactly when and how much water their farm needs. This ensures that water is not wasted, nor is there any leaching into the aquifer.

Their approach to locking up land as a nature reserve and their regular revegetation activities ensure that the environmental integrity of the local area is not lost forever.



The Ingerson farm draws its water from the River Murray.



Inter row cover crops in the citrus orchard

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ITEM	HOW OFTEN
Pests and beneficial insects	Weekly in peak season
Water table	Once a month
Salinity levels	Once a month
Soil moisture	Every irrigation
Native vegetation	Ongoing

Schedule of monitoring activities

Benefits and Costs

Judy and David have always had a passion for their environment and they began revegetating their property when they first got married, thirty years ago. Over the years they have developed their environmental activities to reach the point where they are today.

Their belief in the importance of biodiversity was reinforced recently, when they found that the existence of an insect pest in their orchard was directly related to the status of soil biota in the orchard. Because of this they have started a program of building up soil biota through the application of composts in the hope that they will be able to manage the pest through a balanced ecological system, rather than having to resort to insecticides.

According to David and Judy, the environment is simply another part of their overall management and they do not view it as an added burden. When they make any management decisions, they simply consider what impact that decision may have on the environment. While there may be some added costs because of monitoring and time spent revegetating, they believe these costs are well worthwhile.

David and Judy believe that in the future, their environmental approach to horticultural production will stand them in good stead. They are looking forward to improving their resource base and know that if they are able to continue to provide a product that has been produced with minimal chemical use and with due care for the environment, they will be able to maintain their markets.

The Future

The Ingersons will continue to work with the community and industry to ensure that their industry develops in a sustainable manner and is seen to be employing world's best practice in production techniques.

Consumers are demanding that the products they buy are 'clean and green'. David knows that Australia is 'ahead of the mob' and environmental degradation is not as serious in Australia as it is in other countries. However, Australia cannot rest on its laurels. According to David, the sooner Australian producers adopt improved environmental management, the better off Australian industry will be. The challenge is to maintain Australia's fine reputation. The Ingersons are taking up that challenge.

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Forest Home

An integrated management system

Wesley Hazell

Author:
Genevieve Carruthers

Forest Home, located near Judbury in the Huon Valley in Tasmania, is a 203 ha property bordered by the Huon River. Purchased by the Hazell family in 1975, it is one of a number of farms owned by the Hazell Bros. company and forms part of a group of business enterprises that incorporate civil contracting, earthmoving and transport, quarry and concrete operations, forestry and fleet maintenance.

The agricultural enterprises contribute approximately 3% of the entire company turnover and all costs associated with the agricultural EMS are met from the farms' income.

All Hazell Bros. business operations are managed under an integrated management system (IMS) that covers environmental issues, quality assurance and occupational health and safety. The Hazell Bros. group believes that their IMS has brought significant savings to their overall productivity and helped them gain overseas contracts. More importantly, it has helped tighten up on management across all the company, promoting communication and understanding across the whole business and at the same time ensuring that all partners can easily understand the operations of the different enterprises.

The Farm

Wesley Hazell manages the agricultural operations of Hazell Bros. and lives on the Forest Home property. Prior to the Hazell family purchasing Forest Home, it had been in the same family for three generations and had been used as an orchard and grazing property. Other Hazell Bros. farms are located on Bruny Island (4455 ha running around 23,000 Merino sheep) and at Margate (horticulture).

Forest Home is used for apple and cherry production, cattle grazing and an apple and cherry tree nursery. The apple and cherry, and nursery enterprises each generate 40% of the income, with Hereford cattle making up the other 20%. The 18.25 ha of apples and cherries, and the 1.22 ha used for the nursery area are both expanding enterprises. The nursery area is used for apple and cherry tree production. Approximately 40,000 trees are produced from the nursery each year –80% apples and 20% cherries.

Cattle graze approximately 154 ha of Forest Home and the stocking rate varies depending on market demand. Forest Home also has a tissue culture laboratory, associated with the nursery production area.



Forest Home is in the Huon Valley, Tasmania.



A view across Forest Home pastures and orchards, with the riparian corridor in the background



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One of the pebbly beaches used by local fishermen on the Huon River, which runs through Forest Home

With a 2 km frontage to the Huon River, Forest Home has a large area of riparian vegetation (all of which has been fenced off from stock). The on-farm vegetation is comprised mostly of gums, blackwoods, and wattle. There are also improved pastures of rye grass, cocksfoot, sub and white clovers. Surrounding the farm there are eucalypt forests of brown and blue gums, stringybarks and riparian forests of blue and swamp gums, peppermints and blackwoods.

Forest Home has 16 dams (0.5 ML capacity, on average) which are used for stock watering. Three kilometres of small creeks and wetlands are also present on the farm. The creek closest to the house has a resident platypus.

The soil types on Forest Home vary from the alluvial river flats through to sandy loam and clay soils.

Forest Home is located close to the Judbury Conservation Area, where 53 ha of special vegetation communities are preserved under the Regional Forest Agreement process.

The Staff

Wesley Hazell manages all the farms in the Hazell Bros. group and works on Forest Home with his wife Belinda, sister-in-law Alison Clarke (who manages the QA and EMS programs), a beef/orchard and nursery manager and a wool manager (on Bruny Island). Hazell Bros. also employs a manager for the IMS, in its head office in Hobart. Staff are encouraged to develop solutions to environmental issues and Hazell Bros. links wages with incentives for viable solutions proposed.

The Environmental Management System (EMS)

Hazell Bros. embarked down the path of developing management systems largely as a result of trends in government procurement requirements. It became obvious that over time, Hazell Bros. would start to miss out on government contracts unless they could show they had effective quality assurance programs in place.

As part of the company's work at the time also involved waste disposal on agricultural lands, environmental management was high on the agenda and monitoring of impacts was critical. Wesley believes that the company would have lost contracts without applications addressing monitoring of environmental impacts. He also believes that Hazell Bros. would have come under increasing scrutiny from regulatory agencies. Building on the prior quality programs, EMS was added in and "*the whole business reaped the benefits*". Addressing environmental risks pro-actively was seen as a way to minimise business risks for the operations.

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Other prompts for addressing environmental management came from consultants, an examination of farm profitability and from recognition of resource decline in some areas. Customers provided pressure for food safety and quality assurance of agricultural produce (for example, concerns regarding residues in wool clips), but there was also increasing community pressure to deal with environmental matters. The need to be able to provide a 'traceback' mechanism made the use of systems critical in Wesley's opinion.

The produce from Forest Home and the other Hazell Bros. farms goes to a range of customers. The fruit enters domestic, Asian and European markets. The wool is also sold internationally. Cattle are sold domestically, some within the local area. The nursery stock goes into the supply for the eastern seaboard.

Although Wesley believes that there is increasing general pressure to manage the environment responsibly, he feels that there are few specific issues that come up. In terms of produce, most of the market signals have been with regard to food safety, quality and staff health and safety (mostly from Tesco's and Sainsbury's in the UK). However, Wesley believes that being able to demonstrate good environmental practices will be critical in the future.

The final driver for adoption of management systems was the need for the whole family business to be operated in an integrated manner. Staff from all parts of the company now have clear responsibilities for environmental management that are detailed in job descriptions and performance appraisals. Consistent approaches are now applied in all parts of the business operations. By using a systems approach, Wesley finds that the expectations of all parts of the business are made clear and the interaction of the agricultural enterprises with the other divisions of the business are clarified. With everyone using the same system and following a consistent approach, communication with staff and the other directors has been streamlined. Wesley believes that using a systems approach has made him broaden his focus and look at the bigger picture. *"The IMS is a tool for good management that combines financial, OH and S, environmental, quality and succession planning"* says Wesley, adding that *"good business management can be learnt but not imposed"*. He feels that staff are now empowered under the IMS to help Hazell Bros. meet its business goals.

Hazell Bros. employed a variety of methods to develop their IMS: a consultant was used to develop some of the systems, Hazell Bros. staff received QA and EMS training and contributed to the process, and there was assistance gained from the Tasmanian Quality Fruit IPM program and Tasmanian Quality Wool. Wesley regarded Prograze, the Sustainable Grazing Systems (SGS) program and a computer program 'Paddock Action Manager' as being very useful in helping to develop procedures and practices. Landcare and Greening Australia also provided useful information about specific practices and revegetation.



Hazell Bros. Head Office in Hobart

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Wesley Hazell at the front gate of Forest Home

The Hazell Bros. Group Integrated Management Systems Policy provides the overarching direction for all of the divisions' management approaches. Each of the core divisions also has a division-specific IMS policy. For the agricultural operations, this policy commits the business "to obtaining the highest standards in Quality, Environmental Management and Occupational Health and Safety in all" activities. The elements of ISO 9001, ISO 14001, Cattle Care, Flock Care, SQF 2000 and Meat Standards Australia are all implemented and monitored.

Specific target areas mentioned within the policy include erosion minimisation, selective grazing to ensure forestry regrowth, sustainable timber harvesting, chemical storage and safe handling, and waste management. Many changes to the management of Forest

Home have occurred when compared to past management. Wesley Hazell believes that fencing out the riparian areas, improving drainage and changing stocking rates (including increasing paddocks from 11 to 35, based on land capacity) and fencing arrangements have all contributed to lessening of erosion and dramatically reduced sediment flows into the river. Use is also now made of electric fences. Stock are kept out of wet areas to reduce 'podging' of soils. Overall stocking rates have increased, with rotational grazing used to minimise impacts on the environment. In addition, stock now are used to assist with weed control of blackberries, through the use of 'crash grazing'.

An increase in the attention paid to monitoring has paid off, in terms of gaining more control of the business. The use of tensiometers (at 30-cm and 60-cm depth) for monitoring water levels in soil allows better use of water to be made in both pastures and orchards. Water-use efficiency has also been improved in the nursery area by adopting the use of micro-jet irrigation equipment and the use of misting.

Improved data gained through testing of soils and leaf tissues contributes greatly to determining suitable inputs of fertilisers and herbicides. No fertilisers are added to soils on Forest Home until soil tests have demonstrated what inputs (if any) are needed. Dung beetles are also used to assist in manure incorporation and the inputs gained from manure are calculated before any fertilisers are added to pastures. One to two bags of fertiliser per half ha are used as top-up fertilisers every 2-3 years now, rather than the past practices of 'calendar' fertiliser application. Tasmanian Department of Primary Industries, Water & Environment staff are used to assess grass health when required. On Forest Home, it is now a standard practice to only ever treat every second row of trees in the orchard for any particular problem, or for fertiliser application.

Management and replanting of riparian vegetation has been a major focus of the work done on Forest Home in the past few years. Species from the local area are widely used and seedbed regeneration encouraged.

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Adoption of integrated pest management (IPM) practices in the orchards has seen the chemical inputs into the orchard (including fertilisers) fall substantially. The inter-row grass is now allowed to get much longer before it is slashed – providing habitat for beneficial insects, cutting back on vehicle movements and fuel use and soil compaction problems. A practice of purchasing chemicals on an ‘as-needed’ basis minimises storage requirements and has meant that chemical costs overall have been reduced.

The high soil levels of copper, arsenic and lead (partly arising from the sheep footrot baths) present when Wesley took over the farm management have been reduced and contaminated sites cleaned up and fenced off from stock. Soil tests have shown a steady decline in chemical residues when compared to previous levels.

Soil tillage changes (from discing to direct drill) have resulted in an improvement in both soil organic matter and structure.

In terms of infrastructure changes, the number of dams has trebled, fences have been added (or removed in some cases), the *Macrocarpa* hedges removed, a new safer pumping station has been built, the farm tip has been cleaned up and chemical storages greatly upgraded and improved.

Finally, business issues that have changed as a result of EMS implementation are a longer-term approach to planning, a greater emphasis on staff training, more attention being given to recording and monitoring progress based on key indicators and a high level of communication with neighbours, regulators and customers. Records are now predominantly kept on computer, with paper-based systems as a back up. Originally, 9 copies of the agricultural management manual were kept, but these have now been networked onto the computer systems and hard copies of IMS documents are only made available to the people who need to refer directly to them.

Monitoring

An audit program is in place with internal audits conducted quarterly and external audits done every 6 months. Following two years’ successful implementation of the management systems, these external audits will move to being annual events. The data collected through the various monitoring programs is built into all routine decision-making, with April and May being the ‘reflection’ times for the business. Wesley feels that the data collected through monitoring improves his decision-making.



Regenerating riparian vegetation



The old and the new: the new pump house (on left) is safer for staff and more reliable for water supply than the older pump (on the right).

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Pheromone traps are used to monitor pests in the orchards.

ITEM	HOW OFTEN
River nitrate and sediment levels	Bi-monthly
Waterwatch monitoring	Annually
Soil nutrients	Cores samples are taken when required (always pre-planting or fertiliser application)
Leaf tissues and crop health	Annually
Integrated pest management sampling	Weekly in fruit season – crop walks, traps and by casual observation of orchard staff.
Weather conditions	Weekly reports from on-farm equipment and through ServAg in Devonport
Staff training (includes chainsaw handling, first aid IMS and animal welfare/handling)	Training matrix and register reviewed as needed
Fuel and chemical use	6-monthly review of budgets
Powdery mildew and black spot conditions	Weekly weather reports include these items.
Yields	Annual review of key performance indicators of kilos of beef, apple crops etc.

Schedule of monitoring activities

Field days, reports and conference papers have all been used to disseminate information about the IMS at Hazell Bros. and to gather information that might help with management on the farm. Various industry groups have also held meetings at Forest Home, to see the IMS in operation. Wesley reckons that “*an eyeful is better than an earful*” and he encourages people to visit the property to see what he is doing. Wesley gathers information on changes to legislation and industry trends through the Tasmanian Farmers and Graziers Association, the auditing companies that he uses and through industry magazines. Part of Alison Clarke’s role is to follow up on any of these changes to assess their implications for farm management.

Benefits and Costs

Wesley feels confident that his overall management has greatly improved as a result of implementing a management system. “*I now have a much better understanding, not only of the importance of planning, but also of my business overall*” he says. “*Savings in production are achieved by good management and I am now much more critical of the processes we use and examine things a lot more closely*”. Overall, the ‘bottom line’ performance of the business is better (profits have increased by approximately 20%), with higher yields, improved stock and plant health and increased profits all being reported. For example, in a period of drought when the industry lambing rates were on average 20-40%, Hazell Bros. farms were achieving 65%.

Wesley states that he moved from a loss to a profit in two years, as a result of reducing costs through better management. In addition, assured supplier status has been achieved for Sainsbury’s in the UK and Woolworths and Coles in Australia, with at least one contract being gained in East Timor as a result of Hazell Bros. being able to demonstrate their environmental stewardship.

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Environmental benefits noted have included an increase in biodiversity, improving soil and water quality, improving soil organic matter levels, less time required to fix environmental problems and improved waste management.

One particular benefit Wesley has seen from the systems approach is that the lines of communication throughout the whole company are now much clearer. Staff now have defined roles and responsibilities and can take action more effectively to implement improvements where needed. External communication has also improved, with Hazell Bros. now finding it easier to tender for contract work, as they have information readily available to supply regarding where the business is heading environmentally. The dollar value of these changes is very hard to quantify, but Wesley believes that the peace of mind and the confidence gained in management practices for both he and his staff are considerable.

Other 'social' benefits include improved community relationships and industry image, improved staff health, safety and morale. Wesley believes that relationships with Government departments have improved considerably and thinks that it would now be easier to get development approvals than before.

Business benefits also include the ease of gaining licences, lower risks and liabilities, ease of meeting legislated requirements and much less time needed to fix problems.

A greater use is now made of contractors in Forest Home (for hay and silage making, fencing and some spray operations), resulting in significant savings in both capital equipment and time required to service vehicles. On-farm tractors that have been retained are now serviced pre-season, rather than on the previous 3-monthly cycle (whether a service was needed or not). Hazell Bros. are also more demanding of their contractors now, in that they either seek assured suppliers/contractors or set more detailed and specific environmental obligations for the contractors that they use.

By selling unneeded farm equipment (resulting from the move to more use of contractors), approximately \$300,000 was freed up to return to the business.

Hazell Bros. are paid \$100/ha per year to manage part of the Bruny Island property that is a nature reserve under the Tasmanian 'comprehensive and adequate reserve' or CAR scheme. Restricted grazing practices are allowed on this site, to protect the white gum community there. Swift parrots, 40-spotted pardalotes, wedgetailed and sea eagles (all registered species with Tasmania National Parks and Wildlife Service) nest on the Bruny Island farm. Locations of all these nests are registered on a voluntary basis with the Tasmanian National Parks and Wildlife Service. A fencing incentive scheme provided assistance for fencing out remnant habitat patches on Bruny Island.

Market differentiation is achieved for Hazell Bros. produce in a number of ways. The company uses the MurrayField Gold brand on wool bales, under the Tasmanian Quality Wool Pty. Ltd. Brand No: 8. Apples produced at Forest Home are now

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marketed with a signed letter from the Tasmanian Premier that attests to the participation of Forest Home in a quality assurance program. Both these initiatives serve to distinguish Hazell Bros. products in the marketplace. Information about the QA and EM systems is also included in any tender documents that the company submits. However, as yet there is no direct marketing to consumers of environmental management issues.



Hazell Bros. now manufactures and installs safe chemical storage sheds and sumps as a new business venture.

In improving chemical storage sheds for their own operations, Hazell Bros. had to embark on considerable exploration and negotiation with the Tasmania EPA to determine the requirements for the sheds and to ensure that the sheds they were building would comply with these requirements. Turning a regulatory necessity into a business opportunity, Hazell Bros. now manufacture and install chemical storage sheds for other farmers.

In terms of costs, the major areas of expenditure were for consultants' fees and extra staff time. Wesley estimates that full development of both the QA and EMS components of the IMS took around 14 months.

During the initial EMS development, \$4000 was spent for consultants' fees, with an additional \$2400 per year now being required to pay for someone to manage the manuals, monitoring and records. Monitoring laboratory costs are less than \$1000 per year. Computer and office supplies account for approximately \$2200 per year.

Finally, audit costs for the EMS component are around \$1000. Combining EMS audits with other auditing processes on farms assists in keeping the costs down. Wesley states that it is now much easier to assess costs, as he has a better knowledge of expenditure and also the effectiveness of management changes. Without the EMS he believes that Forest Home would still be losing money and that potentially the company could have received fines as a result of waste disposal practices followed in the past.

The Future

Wesley believes that environmental pressures will continue to grow in the future, placing an increasing demand for responsible production practices on farmers. His own management goals have now changed as a result of his growing understanding of environmental impacts and management of systems. He feels that profits are a matter of good management, not good luck, and that using a systems approach enables him to progress toward the goal of being a better farmer. Wesley is also very confident that agriculture will have a strong future as it takes environmental issues into greater consideration.

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For other farmers adopting an EMS, Wesley recommends taking things one step at a time, working at a pace that enables achievements to be made, without feeling overwhelmed. He sometimes gets frustrated that he can't do everything at once on his own farm.

Wesley recommends getting others involved where possible, making the best use of local expertise. He also suggests that if a consultant is to be used that they need to be chosen wisely. Having a source of independent advice would have been useful when he was developing the EMS for the farm, but Wesley found that the Tasmanian Department of Primary Industries, Water & Environment did not have staff who were able to assist with systems development (despite providing advice on specific environmental issues).

Wesley feels that various incentives would help farmers to get more involved in EMS work. For example, when areas are set aside for conservation purposes, these areas should not be included in rate assessments (as long as they are not used to generate income). Conservation agreements could be used to specify how these areas are to be managed.

Wesley also believes that all of the agricultural industry must be involved in adoption of improved management. *"Farmers associations (both State and Federal) should be taking the lead in this area"*. However, Wesley adds that if industry doesn't take up the challenge within a reasonable time, then legislation in the future might be inevitable.

The proof and documentation features of the EMS, the supply chain management and trace back mechanisms are all seen as critical future issues by Wesley. *"In Tasmania, the clean and green image can only be proven by a system"* he says.

"There has been a lot of hard work so far, but it has been worthwhile. Hazell Bros. has gained a lot from the experience. The EMS has helped set the business side of things right". Although Wesley can see that the number of environmental issues addressed in his EMS will grow in the future, he is confident that the processes he is employing will enable him to meet these challenges effectively. Wesley also stresses that the Integrated Management Systems and the inherent philosophy behind the IMS mean that the company will apply continual improvement to all business operations. The structure of the company in the future will not always remain the same and the company will respond to market and economic circumstances in a proactive and timely manner. The flexibility of the IMS is an important feature to allow such changes to occur.

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Author:
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Moreton Hill

Meeting market demands from Europe

Ruth and Philip Paterson

Ruth and Phillip Paterson use the 121 ha Moreton Hill farm, near The Oaks in Tasmania to grow vegetable crops, grass seed and for sheep and cattle grazing.

The farm was originally purchased by Phillip's grandfather and the houses and sheds were built in the 1930s. The farm had traditionally been used to grow cereal crops in the 1940s and 50s, but in the 1960s there was a move to dairying.

Ruth and Phillip took over the farm in 1984, following a period of several years when they leased the farm from Phillip's uncle. In 1988, prompted by a drought (with associated high feed bills) and the loss of milk quotas, Ruth and Phillip moved away from the dairy enterprise into vegetable cropping.

Poppies had been grown since the move out of dairying, but other early crops included grass seed production and peas. Potatoes were included in the early 1990s.

Ruth and Phillip recently took part in a Tasmanian State Government supported program to assist farmers to participate in the Nature's Choice farm planning program and the audits required by Field Fresh, purchasers for Tesco Supermarkets in the UK.

The Farm

Market demand dictates the exact mixture of crops grown. At the time of interview, Ruth and Phillip had poppies, peas, bush beans, potatoes, broccoli, onions, pyrethrum and pasture seeds either planted or planned for planting.

Approximately 500 Corriedale ewes and lambs graze Moreton Hill and five cows are kept on the farm. In summer, the sheep are agisted off the farm, at the nearby Agfest site.

The farm had been extensively cleared in the past, but Ruth has spent a lot of time replanting *Eucalyptus nitens*, *E. ovata*, black gums, blackwoods and black peppermints to form shelter belts and corridors. A small stand of black peppermints is the only area of original native vegetation left on farm. There are also a number of *Macropus* hedges present on the farm.

The farm has around 1km frontage to the Liffey River and water is pumped from the river into farm dams. However, in the 12 months prior to this interview, this has not been required, due to good rainfall.



Location of Moreton Hill farm near The Oaks in Tasmania



Ruth and Phillip Paterson



A new onion planting on Moreton Hill

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A supplementary water supply comes from the Cressy Irrigation Scheme.

The soil on the farm is a brown clay loam, over a parent material of basalt. A seam of iron stone gravel runs through the farm and several areas required drainage to allow cropping to occur.

Goshawks are known to nest on the farm and so harvesting operations must take into account the nests of these birds. Black swans also nest around the farm dams. Striped bandicoots, tawny frogmouths, small green lorikeets, masked owls and platypus are all known in the area, with the occasional wombat and wallaby browsing on the farm. Tasmanian devils have also come onto the farm from time to time.



The Liffey River forms one of the boundaries of the farm.

The Patersons believe that the actions they have taken to improve drainage are helping to prevent salinisation problems occurring and improve the viability of their cropping enterprises. As the farm is located at the bottom of the catchment, they are concerned about the overall water quality within the catchment. The nearby town, Bracknell, has grown considerably in the last 20 years, yet is still unsewered. Septic leaching into the river is seen as a potential major problem.

The Staff

Ruth and Phillip employ a full-time farm hand, William Burden, who has previous experience with the Nature's Choice program in the UK. They have found that William's experience has been very useful when developing their farm plan. William has a Diploma in Agriculture and a background in cool climate vegetable production.

Up to 15 casual staff are also employed, one for shearing work and the others for vegetable production. All staff receive Occupational Health and Safety training with other training provided as required. Phillip has a Chemical Users certificate and a First Aid certificate. Ruth puts her experience off-farm (working in various clerical occupations, most recently as the Rural Women's Coordinator with Tasmania's Department of Primary Industries, Water and the Environment) to good use on farm, managing the computer records.

The Environmental Management Program (EMP)

Most of the changes associated with management of Moreton Hill have occurred due to financial considerations. The loss of production and income from dairying due to droughts was the major driver for the enterprise changes.

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Market pressures were major motivators to more formally address farm management issues, particularly the occupational health and safety areas. This pressure was predominantly due to the Field Fresh onion crop buyers demanding that produce be grown according to the Nature's Choice program. This program provided guidelines and checklists against which to evaluate performance.

While there is no overall environmental policy statement for the farm, specific management areas are addressed by particular statements. "Rational Use of Pesticides", "Rational Use of Fertilisers", "Pollution Prevention", "Efficient Use of Energy", "Water Use", "Recycling" and "Conservation and Wildlife" statements have all been developed to meet the Nature's Choice requirements. These areas are all drawn together under the Integrated Property Management Plan (IPMP). In addition, Ruth and Phillip utilised a Bush Care assessment to determine areas for conservation on their farm.

Ruth and Phillip never wanted to own the biggest farm in the district, but they did want to end up with one of the most sought after properties. One of Ruth's initial aims was to have trees along every fence line, with shelter in every paddock. Apart from the benefit for stock, return of biodiversity was seen as a major benefit of tree planting. For a number of years they planted about 200 trees per year, but stopped this practice about 5 years ago. Not all of the trees they planted have survived and there are plans to renew planting soon. Many of the fences associated with the dairy operations have been removed and the old dairy paddocks put under oats. In the next five years Ruth and Phillip plan to turn these areas into plantations, possibly of exotic tree species. An application for Natural Heritage Trust funding is being developed to support this work.



Ruth checks chemical stocks regularly.

The storage of farm chemicals and fuel has been changed (as required under the Nature's Choice program) and all storage areas are now bunded.

Waste management has also been addressed on Moreton Hill. The aim is to prevent wastes occurring to start off with and then to recycle where possible. Glass, waste oils, tyres and metals are all stored prior to appropriate recycling. Waste paper is reused as mulch for the trees in shelterbelts, with waste timber used in home heating. Food scraps are fed to farm animals.

Rotations on the farm have changed and more use is now made of winter cover crops. One main aim is that all paddocks only receive one pass of cultivation equipment each season. Drainage and underground water movement and drainage problems have also been addressed.

Most of the irrigation on Moreton Hill is now done at night. "This achieves two objectives – evapotranspiration is lower then and the tariff for electricity is also lower at night" says Ruth.

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Use and keeping of records has also increased now, as has communication with people off the farm. While it takes time to do this, Ruth and Phillip can see that it is useful. For example, they don't receive payment for their vegetable crops until the paddock record sheets have been supplied to their agents.

Phillip and Ruth used consultants, provided as part of the Nature's Choice program, to help them develop their farm plans. They received assistance from the Tasmanian Department of Primary Industries, Water & Environment, the Environmental Protection Agency, the Agronico company and their neighbours and other farmers.

They also did a lot of reading and listening, receiving both printed and media information through a variety of formats. They had no previous experience with best management practices or codes of practice. They now feel that it will be easier to use these and plan on working towards Flockcare in the future.

They are now sharing their experiences with others. Philip is the Chairman of the Lower Liffey Landcare group and both Ruth and Philip have presented talks at a variety of conferences and farmers' meetings. Ruth was also winner of the 1994 Tasmanian Rural Woman of the Year competition.

Monitoring

"Personal confidence in management is important, but it is hard to measure" state Ruth and Phillip. To help them determine that their management is having the effect they want, they use a variety of measures.

Results of monitoring are incorporated into management in differing ways, depending on the issue. For example, gaining premium prices for broccoli depends on the timing of supply and so Ruth and Phillip must manage planting in a small window of time. The soil condition, availability of water and rotations must all be considered. Other management issues have greater flexibility, such as tree planting times.

ITEM	HOW OFTEN
Soil management	Soil cores are taken at least every 3 years, or at the beginning of each rotation, depending on soil use.
Equipment and vehicle maintenance	Fuel use and maintenance records are reviewed as needed
Chemical, water and fertiliser use	Reviewed pre-harvest, with records sent to processors
Integrated pest management monitoring	Crop walks and bug checks are done on an ad-hoc basis
Sap testing for potato nutrient status	Leaf samples are taken and sent to the laboratory weekly in season.
Waterwatch Group sampling	School groups collect stream insects annually
Native bird numbers	Ad-hoc identification when observed
Financial performance	Ruth, Phillip and their accountant review accounts monthly
Market appraisal	Prices received for produce are reviewed weekly in season

Schedule of monitoring activities

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Most farm records are kept on farm diaries or paddock records sheets (organised on ‘tear-off’ pads so that they are easy to supply to buyers as required), but financial records are also kept on computer using the ‘Phoenix’ program. Ruth and Phillip intend to increase the number of records that they keep. *“Organising the records means that overall record keeping is now much easier”*.

Benefits and Costs

One of the major benefits for the farm is that now when Ruth and Phillip complete the occupational health and safety checklist sent by their insurance company, they can answer “Yes” to most of the questions, whereas in the past, the answer was generally “No”. In general, they feel that they are more easily able to ‘prove’ that they are doing their best to manage their farm in a safe and sustainable manner.

Ruth and Phillip believe that by taking part in the Nature’s Choice program and audits and meeting the Field Fresh specifications, they have broadened their management focus from purely tree planting to include more soil, water, biodiversity and river management issues.

Yields on the farm have improved (partly due to better drainage) and stock health is also better. Ruth and Phillip attribute gaining at least one new market, “Fresh Select” at Werribee for broccoli, to their overall management approach. This contract resulted in a doubling of the acreage of broccoli grown and also resulted in the hiring of more staff members. Profits should eventually reflect these benefits, but at present, no price premiums are received.

Ruth and Phillip feel that some of the most important benefits are those associated with liabilities for staff welfare. *“We have much lower liabilities now for workers’ compensation”* says Ruth *“and greater peace of mind”*. In addition, there is more of a business management approach on the farm.

Increased biodiversity over time is also seen as a major benefit. There are now increased trees on the farm, with associated numbers of birds. The trees also have another spin-off benefit. *“The farm overall is now ‘one jumper warmer’”* says Ruth. *“The tree buffers have cut both the chill factor and the strength of the wind that used to cut across the farm and stock generally perform better.”* Ruth now finds she wears one less jumper when working outside in winter. *“The farm is aesthetically more pleasing, too”*.

Although many of the above benefits are hard to quantify, Ruth and Phillip now pay discounted workers’ compensation insurance rates. They have also been able to lease another 20 ha for poppy, potato and wheat production, as the owner of the land felt confident in their management.

In dollar terms, Ruth and Phillip say that the highest costs associated with work on farm were those for drainage works, then with the quality assurance program,

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followed by the shelter belt work. In terms of time however, the tree planting required the most resources, with QA program again second, and drainage the least time consuming.

Training costs the Patersons \$500 annually and they spend about 4 days a year attending courses. The Nature's Choice and Field Fresh audits were subsidised through Department of Primary Industries, Water and Environment and the State Government. Other audit costs were \$250. The infrastructure required to improve the chemical and fuel storage areas cost \$9000.

Finally, monitoring and administration requires about 1 hour per day (which has declined from the one day per week required at the start of the program). Some of the farmhand's salary is also attributable to the environmental management.



Drainage work on a paddock beside the dam

The Future

Ruth and Phillip advise anyone who makes management changes to *“keep it up once the initial investment of time has been made”*. Although they were disappointed that the promised price premiums did not result, their increased focus on management is benefiting their business. They feel that they would have lost market share over time if they had not made the changes.

They are more confident in their management and feel that they have better direction in working towards their goals. The growing market interest in organic foods and environmental management is seen as an indication of increased consumer pressure for ‘green’ production methods. In time, an eco-label will be developed for farm produce, in an attempt to capture the ‘green market’.

However, Ruth and Phillip are only moderately confident in the future of their farm. They believe this is due to a combination of their ages, their children not wanting to stay on the farm and the fickleness of the markets they are trying to meet. By diversifying their operations, doing packing and cold storage on the farm and value-adding produce, they hope to be able to recoup these expenses and potentially obtain a premium for their produce.

“Support for farmers adopting management changes could come in many forms” Ruth says. Provision of templates for record sheets, designs for acceptable fuel and chemical storage areas and before/after case studies would have been helpful when they started out making changes. *“An explanation of pitfalls to avoid, rather than finding them out ourselves, would have been very helpful”* Phillip notes wryly.

Case studies – Tasmania

- Forest Home
- Moreton Hill
- The Hermitage

Farmers should also be able to access either price premiums or tax relief as a reward for good management. Ruth and Phillip did not undergo the Field Fresh audit process in 2001, as they did not perceive a market advantage that year. *“For some reason, only red onions needed to meet the audit requirements and as we only grow white onions, there was no point in spending the money on the audit”* explained Ruth. *“We are still meeting 95% of the program requirements though and could quickly act to take advantage of any premiums that might be paid for audited produce”*.

“Industry groups need to be more proactive and provide leadership, rather than being reactive to problems as they occur” says Ruth. *“More marketing of the ‘good news’ needs to occur”*.

Ruth and Phillip believe that they are in a position to benefit from this ‘good news’. They have records in place to help them ‘prove’ that they are doing a good job and they are confident that their management will assist in making their farm the *“most sought-after farm in the district”*.

Case studies – Tasmania

- Forest Home
- Moreton Hill
- The Hermitage

The Hermitage, Roxford and Lornebrook

Paul and Tina Badcock

Author:
Genevieve Carruthers

Paul and Tina Badcock own the 138 ha The Hermitage and 28.5 ha Roxford farms in the central north of Tasmania. They also lease an 81 ha farm, Lornebrook, from Paul's father. The Hermitage and Lornebrook have been owned by Paul's family for some time (22 and 50 years respectively), whereas Roxford was purchased in the 1990s.

Paul began to address environmental issues largely as a result of his concern for resource sustainability, but also was driven to this management by increasingly stringent demands from customers. In particular, the company that exports the onions that Paul grows required that suppliers participate in the Nature's Choice program (used by Tesco's in the UK as an assured supplier scheme). However, in the long run, Paul has found that his own pride in his work has been a better motivator to improve than any scheme imposed from outside.



Paul and Tina's farms are located near Latrobe, in northern Tasmania.

The Farm

The Hermitage is used to grow vegetables, cherries, poppies and to agist cattle. Approximately 60 ha are used to grow onions, peas, potatoes, green beans and carrots, with the areas sown to the different crops depending on contract demand. Ten ha are under a cherry orchard, with a further half hectare used as a cherry nursery. Poppies (grown for medicinal products and seed) occupy roughly 40 ha. Roxford and Lornebrook are also used for vegetable production. Cattle graze some 21 ha at Lornebrook and are agisted on 27 ha of The Hermitage.

A small agroforestry block has been established at Roxford, but overall, remnant vegetation on the farms is very sparse and comprises only around 1-2 ha. Tree windbreaks have been established on The Hermitage and a small area of tea tree and blackwood is present near a wetland area. Remnant patches of blackwood and tea tree and sparse understorey shrubs represent the remainder of the on-farm vegetation on The Hermitage.

Most of the water supply for the farm comes from the four dams located on The Hermitage. Three creek systems drain through the farm – Panatarna Rivulet, Eastford Creek and Westford Creek.

The soils are krasnozems, black earths and clay loams over clay subsoil. Slope classes range from 1-4, with undulating low hills present.



Poppies are grown for medicinal products on The Hermitage.

Case studies – Tasmania

- Forest Home
- Moreton Hill
- The Hermitage



Some of the remnant vegetation on The Hermitage

A biodiversity audit of The Hermitage (conducted to fulfil part of the Nature's Choice program) found no endangered or threatened species on the farm, but did highlight the presence of some rare bird species (swift parrots, goshawks, peregrine falcons and wedgetailed eagles) in surrounding areas. A church and two houses also lie on the borders of The Hermitage and, together with the wetland, are regarded as 'sensitive' areas.

Paul's income comes mostly from farm production, but he also does contract orchard management. Until recently, Tina was a teacher but she now works on the farm full-time. Vegetable production contributes 65% of income, cherries 13%, poppies 10%, agistment of stock 7% and the nursery 5% (although this is expected to grow).



Onion field, with cherries in the background

Some of the funding for the revegetation work has come from Landcare and involved a local school group. Paul is a member of the Understorey Network and this group is propagating a number of species of plants for use in the school's revegetation project. NHT funding was also received for fencing and revegetation work and the wetland area is a Land for Wildlife site.

The Environmental Management Program (EMP)

The major issues that Paul has tackled are riparian zone management, use of buffer zones and soil structure management. Cropping represents the biggest management area environmentally on-farm with stock access to waterways also a problem. About half the riparian zones (2 km) have been

fenced off so far to manage this issue.

Paul's written farm plan addresses five areas for environmental work. Revegetation is regarded as the most critical issue. In a novel approach to the recognition of the dangers posed by falling limbs from old and dying trees, Paul now plants around them with buffers of revegetation, thus achieving the goal of safety and revegetation in one go.

Wildlife and landscape ecology were two focus areas of the Nature's Choice program. Other areas that were required to be considered under this program were energy use, occupational health and safety, wildlife and game management, and pollution.

The enterprises on the farms are mostly the same as when Paul took over management of the farms. However, more cherries are now grown in response to market demand and the ability to sell at a peak demand time. Paul also feels that cherries offered greater lifestyle benefits in terms of time. Cattle are now only kept on-farm on an agistment basis and Paul finds that he is getting the same income from agistment as he used to get from contract rearing of heifers.

Case studies – Tasmania

- Forest Home
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Paul feels that his father did not really address environmental management, mostly because it was ‘not the done thing’ in those days and also because there were no perceived economic benefits in doing so.

In the past, chemical management was seen as the highest priority issue, but Paul feels this area has largely been addressed.

Land capability is recognised as an issue, but is not addressed on-farm currently as market pressure, and not environmental considerations, dictate the crops grown. However, the timing of crop rotations and grazing management are used to address soil compaction and erosion. Paul works with the Rubicon Catchment Coordinators to address these issues and also uses this group to source information on specific areas of resource management.

Other useful sources of information were the Tasmanian Department of Primary Industries, Water & Environment, Landcare, Greening Australia, and the Parks and Wildlife service.

Paul also referred to the Onion Growers Code of Practice, but says that this gave the individual farmer little control and made him feel as though he was being dictated to by contract customers. Paul also receives information from the local Catchment Coordinator and the Understorey Network. Agronomists visit the farm between 6-12 times per week, although he only pays for one of these visits (the others are from agents). In some cases, he has had to use these advisers as part of contractual obligations. Field days and meetings are other important sources of information.

Monitoring

Whilst Paul does not have any formal processes for incorporating monitoring into decision-making processes, he does use the soil tests to assess inputs required before planning each year. Information is usually recorded onto farm diaries and then put onto the computer records at a later date.

ITEM	HOW OFTEN
Soil pH, CEC, organic matter and nutrient status	Cores are taken from each paddock every three years
Water use and soil moisture	A ‘Gopher’ system (computer linked) samples weekly
Water quality in creeks	Samples are taken several times a year
Leaf nutrient status and sap monitoring	Leaf discs are taken on an ad hoc basis (sent to laboratory for analysis)
Pest numbers	Weekly crop walks in season
Financial reviews	Quarterly examination of computerised cash book, with accountant

Schedule of monitoring activities

Case studies – Tasmania

- Forest Home
- Moreton Hill
- The Hermitage

Paul believes that the changes he has implemented in record keeping make it easier for him to prepare budgets and that the records kept make it easier to analyse trends for management and to reflect on achievements.

Benefits and costs

Paul is unable to put a dollar value on the benefits that he feels he has received so far, as many of them are to do with overall confidence in management and the improved ability he has to tell people about how he manages his farm. The risks and liabilities for Paul's business have been lessened by his adoption of more rigorous management. He feels that his farm is more sustainable, the decline of the resource base has slowed and problems with neighbours will be less likely to occur in the future. He also feels that without making the changes he has, yields on the farms would have dropped over time.

Paul also believes that he gained a game licence (for control of feral animals) more easily because he was able to demonstrate his commitment to sustainable management.

Because of improved chemical storage and handling, Paul believes that the health of his family and staff is better protected on the farm. This has been reflected by the reduction in workers' compensation insurance premiums that Paul now pays – a 1.5% premium reduction.



The deep chocolate soils on The Hermitage are improving in structure over time, due to careful management.

Although participation in the Nature's Choice program did not result in the promised price premiums, Paul did gain assured supplier status for his onion crop. The vegetables Paul grows have both domestic and international markets, while the cherries are solely for domestic sale.

Paul has noticed that the soil structure on the farm is improving, erosion is reducing and that biodiversity is increasing. Although the use of chemicals has increased to meet QA requirements, Paul hopes that he will be able to reduce chemical use in the future, through closer management.

Paul has spent under \$1000 on training to assist him with improved management. He employed a consultant at a cost of \$5000 and spent around \$10,000 to improve chemical and fuel storage using sumps and bunding (although he points out that he would have had to do this work irrespective of whether he participated in the Nature's Choice program).

Case studies – Tasmania

- Forest Home
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Monitoring for the farm costs around \$2000 but not all of this is for environmental issues, as much of the monitoring also provides production information. Paul also purchased software to help him track financial records better – this cost around \$1000.

Paul did not pay for any of the audits, as his farm served as one of the trial sites for the Nature's Choice program. Because the premiums promised did not eventuate, Paul is unsure about whether he will continue meeting all the program requirements for Nature's Choice.

However, as he says "*Money was the motivator*" and he believes that without that initial incentive for involvement, he would have taken a lot longer to get around to implementing the changes that he has made.

The major cost for Paul has been in terms of time. He now spends around one day a fortnight doing administrative tasks and feels that this 'managing' takes time away from 'farming'. However, he does find it useful to be able to review records, both to help with budgeting and to reflect on what he has achieved.

The Future

Paul recommends that anyone who wants to address environmental issues on-farm should do an environmental audit first off, to gain an understanding of their current level of operations. These audits will be most effective if done by someone not related to the management of the farm.

Having good examples of sound environmental management is one of Paul's wish list items – "*It would have been useful to have good examples of people who had made changes*". Paul believes farm visits would be a good way to help provide this information.

However, he does not see that this should be a role for industry development officers, stating that their role is more about helping people make more money. Rather, the environment is seen as an area for community support. Consumers probably won't support environmental work, Paul feels, as they will always buy according to value for money. On the other hand, supermarkets should use assured suppliers (even in years of low supply and high demand) as an incentive for farmers to "*do the right thing*".

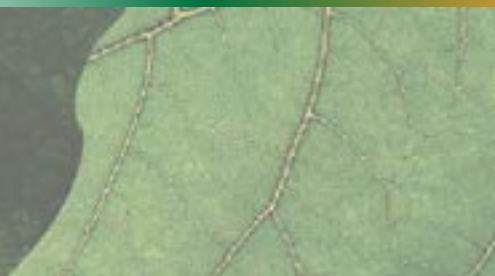
Paul believes that the changes he has made on his farm will enable him to meet requirements for assured supplier status and demands from the community for improved environmental practices. An important means to provide this accountability is through the records that he now keeps.



Fuel and chemical storages were bundled as part of the Nature's Choice program.

Case studies – Tasmania

- Forest Home
- Moreton Hill
- The Hermitage



Guyescliffe

Early recognition of environmental issues pays dividends for WA producer

Kim and Dianne Diamond

As early as the 1960s Kim Diamond recognised that his farm was becoming non-viable due to the effects of dryland salinity. He decided to challenge this and set out to do something about it. Kim's efforts were recognised in 1999/2000 by winning the National Landcare award. But more importantly, Kim's efforts towards combating dryland salinity on his farm, have made the farm what it is today : a profitable and sustainable operation. The Diamond family's vision is:

"To have responsibility for the welfare of the landscape and our own profitability ."



Kim and Dianne Diamond with their Landcare award

The Farm

The property, Guyescliffe, is located approximately 250 km north of Perth, in the North Midland wheat belt region of Western Australia. With a Mediterranean climate, the average annual rainfall is around 320 – 350 mm. Rainfall is winter dominant with most occurring during May to October via westerly frontal systems from the Indian Ocean.

The farm was mostly cleared from 1945 to 1950, with the original vegetation consisting of mallee, pine, tama, York gum, jam, and tea tree.

Since Kim took over the farm, 12,000 trees have been planted, mostly salt bush and river gums, with seed collected and grown in the property's own nursery.

The mixed farm of 3,000 ha has approximately 15 % coverage of shelter belt/ corridors with two houses, shearing and machinery sheds, a workshop and a hay shed forming the infrastructure. It is 350 m above sea level with the topography undulating to flat. The farm is an L-shaped block orientated half north-south and half east-west.

Soil types on the property consist of light to medium loam sands. There is an extensive drainage system throughout the property with open deep drains and shallow surface drains for flood mitigation and surface water management. Deep drains for seepage water management consist of approximately 5 km of 100-mm

Authors:
Chris Cole and
Genevieve Carruthers



Guyescliffe is located near Dalwallinu, WA.



Case studies – Western Australia

- Guyescliffe
- Cooina
- Gillam Farms
- Roadside
- Maybenup
- Payneham Vale
- Wandalup Farm



Prominent signs on the front gate

perforated drainage pipe. Cropping enterprises on the property comprise wheat, barley, lupin, canola and oats. The livestock enterprises consist of a 1,000-merino breeding flock for wool production, 100 head of cattle mainly for breeding, a 50-sow piggery and 100-head feedlot.

The farm generates its income from cropping (50 %), livestock (40 %) and off-farm income (10 %) via contract hay-making and revegetation work. The ability to transfer income between enterprises has allowed the Diamonds to remain flexible with their enterprise choice. Environmental issues have been addressed on a whole-farm basis with no funding from outside sources.

The Family

The Diamond family settled in the North Midland region in 1927 when Kim's father took up the property. With secondary school education, Kim has been farming for 40 plus years. During this time he has undertaken numerous management training courses, consisting of various marketing and land management skills workshops.

Now Kim and his wife Dianne farm the property in partnership with their son Neil and his wife Jo. The partnership aims to:

- have viable production from salt-affected land by reverting land from nil productivity to running 3.5 DSE all year round
- use plant-based solutions and engineering to overcome dryland salinity
- double yield of crops up-slope and grow higher valued crops
- run livestock on salt-affected areas during winter (intensive)
- link food safety, environmental and Q A approach into one, for market recognition.

The Environmental Management Program (EMP)

The property has changed significantly over the years, from virgin bush to monoculture cropping/sheep grazing systems to perennial based, longer-growing season annuals. More recently, summer cropping with forage sorghum (known as a low recharge cropping system) has been added.

Seeing the degrading effects of dryland salinity and the problems associated with weed management under monocultural farming systems prompted the Diamonds to change their focus and ask themselves the question, "*How can we better utilise water in this dry environment?*" By changing their farm layout, the Diamonds started farming according to 'water zones' which they now monitor frequently for quality. Being able to maintain viability both economically and environmentally were key drivers of change on Guyescliffe.

Case studies – Western Australia

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Apart from cultural change, the most significant change has been to work on the contours of the landscape (water zoning). Livestock are run on the low flat areas (valley floors) during the winter months and supplemented with crop residue, along with saltbush. Salt-tolerant trees have been planted in these areas to arrest dryland salinity. The mid-slope areas are winter-cropped using rotations (wheat, canola, barley etc), with some livestock grazing during short pasture phases. Upper slope areas are grazed and rotationally cropped to better utilise the lands' capabilities. A significant fencing program is being undertaken to allow this system to develop and become workable.

The main environmental issues for the Diamonds are:

- water table management
- soil physical & chemical attributes
- salinity and drainage
- biodiversity.

Recently the Diamonds adopted Quality Assurance for the pig, cattle (intensive) and grain enterprises on the farm using the SQF 1000 system.

Kim is a strong believer in maintaining small communities together. His role as vice-president of the Liebe research & development group has allowed him to encourage other landholders to adopt new technology, including sustainable farming systems.

Monitoring

Through his own observation and monitoring programs, Kim has recognised those issues stated earlier as high environmental priorities on his farm.

Monitoring results are fed into management decisions on an on-going basis. Records are kept in both paper and computer formats.

ITEM	HOW OFTEN
Water table	Piezometers as required
Soil physical and chemical condition	Annually, pH test done on farm regularly
Salinity	Once a month

Schedule of m onitorin activities



Neil Diamond with forage sorghum seedlings, sown to use excess water

Case studies – Western Australia

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Benefits & Costs

As cost of production increased, it made sense to the Diamonds to look at returns from more intensive operations (feed-lotting), as this would take away the need to acquire more land.

A major benefit will come in terms of market access. The Diamonds believe that over time they will gain increased value for their produce, if they can identify to markets and consumers that they are employing improved environmental stewardship on their property as part of their day-to-day management.

Kim estimates that, over the past 30 years or, so attending to dryland salinity on the property has cost between \$250,000 and \$ 300,000 (i.e. between \$8-10,000 per year). The infrastructure of drainage, fencing and changing watering points contributes to a large proportion of this cost.

These changes have made management more complex due to new enterprises now operating on the farm. However, Kim points out that there would have been financial costs had the changes not been made. Land would have been lost to production entirely. Estimating the cost of that is difficult.

The Future

Kim is confident in the future sustainability of his system. *“I wouldn’t be doing it if I wasn’t confident”*. Currently Kim is involved with developing an environmental audit with the Department of Agriculture-Western Australia to make current farming systems more accountable.

The Diamonds will continue to work with community and industry groups to ensure that the management strategies they implement address the environmental issues facing their industry.

“The role of government should be to continue to support groups and individuals in their endeavours to better manage the environment”. The Diamonds firmly believe that if food quality, quality assurance and environmental management can be linked together, this would go a long way to gaining the market recognition they, as producers, are seeking. The Diamonds also believe that this approach would be the best possible incentive to encourage other producers into adopting these types of management approaches.

Case studies – Western Australia

- Gyescliffe
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- Gillam Farms
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Cooinda

Moving with change to better manage the environment

Stuart and Leanne McAlpine

Authors:
Chris Cole and
Genevieve Carruthers

The McAlpine family is determined not to set aside the benefits of long-term sustainability for short-term profitability. To enable Stuart McAlpine to do this he has to be passionate about managing the environment. But just as important, according to Stuart, is being able to manage change and having an understanding of the whole system, including marketing. The McAlpine family's vision is:

"To leave the environment in a better state than when we started farming, so that future generations can be proud of us."

This of course has to be weighed up against running the farm as a business and maintaining family life. Stuart also plays a very active role in the community as president of the Liebe Landcare group.

The Farm

The property Cooinda is located approximately 300 km north east of Perth in the Midlands wheat belt region of Western Australia.

Situated 343 metres above sea level with undulating to flat topography, the farm has an average annual rainfall of 340 mm. With mid summer temperatures reaching up to 45 °C, the farm is operated in a Mediterranean climate.

The mixed farm is 3,789 ha with infrastructure in the farm consisting of two houses, four dams and machinery and hay sheds. Soil type on the farm is predominantly sandy loam.

The cropping enterprises consist of wheat, lupin, canola, barley, oats and lucerne hay, with sheep and cattle making up the livestock enterprises. The farm generates most of its income from cropping (80%), with livestock making up the remainder. Around 30% of the farm is under perennial pastures.

The farm was cleared in the early 1950s, with the original vegetation consisting of tama tussock and pear tree. Since taking over the farm, Stuart has been planting River gums and oil mallee trees for use as an agroforestry plot, as part of the whole-farm plan. There are also 250 ha of salt-tolerant remnant vegetation on the farm. A 100 ha State Forest nature reserve borders the property.



Cooinda lies close to Buntine, in WA.



Entrance to Cooinda

Case studies – Western Australia

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The Family

The McAlpine family settled in the Buntine area when Stuart's father first started farming in the early 1960s. Stuart now farms Cooinda with his wife Leanne and their two young children. He has two full-time members of staff working on the farm.

With secondary school education, Stuart has been farming for 20 years. He has also had training in business planning and has completed financial and computer courses. As president of the Liebe Landcare group he has attended numerous strategic management training courses.

Stuart is currently using SQF 2000 for his beef and grain enterprises, with most of his produce exported to Japan and Asia.

However Stuart is currently exploring the possibilities of value adding for the domestic market. Although Stuart believes that farmers are not getting clear signals regarding environmental issues in farming at present, he still believes that good environmental management may become a point of market differentiation in the future. He also hopes to gain a premium for his produce, based on QA and value adding.

The McAlpine family aim to:

- reduce the saline areas
- maintain a balanced family life
- gain early market access using environmental management as a marketing factor
- balance short-term profitability with long term environmental goals.

The McAlpines aim to carry out their farming operation with minimal impact on the environment. Although Stuart has a clear idea of where he is heading in the future, he does not have a formalised environmental policy.

The Environmental Management Program (EMP)

Witnessing the effects of dryland salinity along with water and wind erosion first hand were key drivers prompting Stuart to change his management. On the valley floors of the farm are some saline areas that are of concern. Communication with neighbours, industry members and researchers was important in determining the priority environmental issues that needed to be addressed.

Stuart also recognises that, as his farm is located on the head of the catchment, his actions may affect others downstream.

The main environmental issues for the McAlpines are:

- water table and recharge management
- soil nutrients and physical structure (including pH and use of lime)
- soil salinity

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- soil acidity
- wind and water erosion.

To begin to address these issues, Stuart firstly adopted a no-till farming system and more recently has incorporated a perennial-based pasture into the rotation.

Stuart is two years into an eleven-year rotation. This initially began as an eight - year continuous cropping rotation (3 years wheat, 2 years barley, 1 year canola and 2 years lupins), but Stuart soon realised that that particular system was going to be unsustainable due to herbicide resistance and rising water tables. As a result he has added a three-year lucerne phase to the initial eight-year cropping phase.

He planted 250 ha of lucerne in 1998 and a further 220 ha in 2000. There were three main reasons behind the large areas planted to lucerne. These are:

1. to enable a good range of grazing, along with mechanical and chemical options for controlling the weed seed bank
2. to improve soil structure and prevent top soil loss
3. to utilise a perennial pasture in the system to address rising water tables.

On a seasonal management basis Stuart has sown forage sorghum (which is cut for silage) in years following wet harvests, to better utilise soil moisture and hence lower the water table. In the longer term, Stuart believes that this will stop land from becoming saline. This has worked very well to date and will have some long—term ramifications on the sustainability of the farm.



Murray Grey cattle grazing lucerne

Monitoring

Along with change, Stuart maintains “*You have to be flexible enough to sit down and review the changes you have made. Although some of the new systems employed tend to be profitable now, they may begin to run into problems in the future*”. An important part of this reflection is the use of monitoring data.

Stuart has highlighted some key areas to monitor to assist with farm management.

ITEM	HOW OFTEN
Water table	Neutron probes at 3m, readings taken at various times
Soil nutrients and trace elements	On-going
Tree death	On-going observations
Areas of salinity	Visual observations
Acidity	Soil tests and pH meter used on an on-going basis
Plant tissues (for N)	On-going

Schedule of monitoring activities

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The results of this monitoring are used to make management decisions on-farm. Data from monitoring is included as required into these decisions. Records are kept both on paper and computer.

With wide fluctuation in commodity prices, there are risks with financing technology changes that have a reduced impact on the environment. *“Perhaps the greatest risk is ‘seasonal risk’, something we have no control over”*, says Stuart. Stuart believes that it is best to try to manage seasonal variability to minimise financial and environmental damage to his farm and business and sees continual monitoring of activities as one way to achieve this.

Benefits & Costs

Environmental benefits seen so far include reduced wind and water erosion, improved soil structure and potentially improved market access in the future. The adoption of no-till farming has shown quite dramatic results in improving his soil structure, according to Stuart.

However, he acknowledges that, at present, it is difficult to precisely quantify just what the financial benefits have been. As time goes on, he believes that doing this could become easier, especially if all farmers in the industry were to adopt improved record keeping. *“At present, we just don’t have the facts and figures”*, he says.

Stuart has identified better profits and yields occurring as a result of his improved management. He has also gained approved supplier status for his lupins, as a result of involvement in a QA program.

Publicity of Stuart’s approach to environmental management has also helped. He was awarded the “No-till Farmer of the Year” prize in 1999 in recognition of his efforts. He believes that the publicity has assisted with marketing his lupins. The industry image is also improved by his efforts, he believes.

Stuart recognises better family and community life as a benefit, which he believes is very important. Further, he feels that in the future, less time will be required to address environmental and business problems.

While there are added costs associated with the changes, such as the on-going monitoring, Stuart believes it is very difficult to put an actual figure on the overall cost. He estimates that the lime and seed required to establish the lucerne phase costs around \$150 per ha.

But there would have been even greater cost associated with loss of production through salt effected areas and soil / water degradation, had he not addressed these issues.

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The Future

The McAlpines will continue to work with community and industry to ensure their industry develops in a sustainable manner, employing best management practices where possible. Stuart believes very strongly in grower groups supporting each other because, as individuals, it's difficult to keep up with changes in technology. Such communication has been a feature of the Liebe group. *"Farmer-driven and focused groups should be able to provide the information needed to make management changes"*, says Stuart. He also pointed out that local councils and resource management agencies at present do not have the infrastructure in place to help farmers make the sort of changes he has and he would like to see this change over time.

"Research should be done at the 'whole-farm' level" Stuart believes. Assistance with documenting changes and monitoring in the form of human resources would also be valuable. Developing new enterprises that are environmentally sustainable is another area of support that Stuart feels could encourage people to adopt improved practices. *"Government, industry groups and consumers should all work together to make these changes happen"*. While questioning the use of an 'environmental tax' as the way to go, Stuart believes that consumers can provide powerful messages to farmers through their buying patterns.

Stuart is confident in the future but is quick to point out that he will have to go to another level of management to better manage strategies, for example, targeting strategies for premiums for QA products. According to Stuart *"Our produce will have a greater chance of success if it is a premium product that is quality assured and is part of a whole-systems approach to farming. We need to demonstrate a responsible approach to the environment and guarantee (to some degree) safety in continual supply"*. Stuart believes that he will move into a full EMS approach in the future.

Stuart believes that his management changes, improved record-keeping and farming system approach position him well to meet a growing demand for 'environmental accountability' in the future. He feels that consumers can support such a responsible approach through their buying pattern. Further, he believes that farmers, by taking community views into account and adding value to local produce, can strengthen local communities and perhaps, in the future, increase rural populations.

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Authors:
Chris Cole and
Genevieve Carruthers



Dongara, in WA, is the closest town to the Gillam Farms.



Entrance to Gillam Farms.

Gillam Farms

Environmental accountability—a key marketing factor for the future

Chris and Christine Gillam

The Gillam family believes programs such as QA and environmental management will become key factors in the future, by making producers more environmentally accountable.

Chris Gillam is enthusiastic about conserving the environment for future generations and is actively involved in community groups. He is currently president of the Mingenew-Irwin group, a collection of farmers working together on sustainable farming practices and research.

The Gillam family's aim is:

"To only adopt practices that are best for the farm and the environment."

Both Chris and Christine Gillam are more disciplined in their farming operations now and only adopt those practices that offer long-term sustainability.

The Farms

The Gillam family currently farms four properties totalling 6,000 ha in the Mingenew-Irwin area. The farms lie 300 km north of Perth in the North Midlands region of Western Australia.

The farms are 100 metres above sea level and are flat to undulating with an average annual rainfall of 450 mm. The rainfall pattern is winter dominant (May to October) with early seasonal breaks coming from tropical air currents passing over the west coast.

The Burgess family first cleared and farmed the area in the 1880s but it wasn't until 1930s that the Gillam family bought their land and started farming 'Gillam Farms'.

The original vegetation consisted of *Banksia* scrub, York & River gums. On Gillam Farms there are now 1000 ha left for shelterbelts and corridors.

Soil types on the properties vary from red loams to clay loams, yellow and grey sands to self-mulching grey clay on the river flats.

Cropping on the various farms includes wheat, canola, faba beans, lupins and barley. The livestock enterprises consist of cattle and sheep grazing sub-clover and grass pastures. Stock are watered primarily via bores.

Case studies – Western Australia

- Guyescliffe
- Cooinda
- Gillam Farms
- Roadside
- Maybenup
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The farm generates most of its income from cropping with the majority from cereals (50 %) and pulses (30 %). Livestock enterprises make up the balance.

Staff

Chris has been farming since 1968, after completing secondary school education. As president of the Mingenew–Irwin group he has attended many farm management seminars.

Staff working on Gillam Farms have attended the Farm Chemical Handling course.

The Environmental Management Systems (EMS)

Most of Chris's time is spent on cropping, management, with attention given to selecting those crops which best suit the range of soil types over the four farms. Farm operation has focused mainly in the area of cropping with greater emphasis on no-till farming. Lupins and wheat are mainly grown on the sand to loam soil types, while the wheat, barley and pulses are restricted to the heavier clay soils.

A major part of Chris's grazing strategy is the use of tagasaste (tree lucerne). This is not only a valuable fodder source but also helps to lower the water table combating dryland salinity. It also serves as a valuable attractant for native bird life.

Using multiple cropping in the early 1970s and as a young fellow full of energy, happy to cut down trees, Chris describes himself as “*like a bull at a gate*” in his early farming career.

However, as time went on, he realised that this was not the way to continue. Witnessing at first hand severe wind and water erosion across much of the farm made Chris realise that something had to change.

Chris now puts a lot more thought into landscape capabilities and doesn't run livestock on the pasture paddocks during summer. Instead he uses crop residue and tagasaste as a fodder source. He has actually increased his whole farm business without buying more land. The Gillams are currently part of the Mingenew-Irwin group undertaking the process of establishing relevant protocols for implementing an EMS based on ISO 14001.

The main environmental issues for the Gillams are:

- wind erosion
- water erosion
- acidity



Chris Gillam with tagasaste, used to lower the water table and offer valuable grazing fodder

Case studies – Western Australia

- Guyescliffe
- Cooina
- Gillam Farms
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- salinity
- river bank erosion.

Because the Gillam’s farm is close to the Irwin River and several creeks run through the farm, management of nutrients and run-off is very important. The Gillams have planted trees close to the riverbank to stop erosion and with no-till farming practices aim to maintain adequate ground cover to prevent erosion.

Monitoring

Chris has highlighted a number of key areas to measure to check whether his management practices are having the desired effects. These are shown below.

ITEM	HOW OFTEN
Wind erosion	Daily, by visual inspection
Water erosion and sediment loads	Daily, by visual inspection
Soil acidity	Soil tests done as required
Nutrients in soil and plant tissue	Tests done as required

Schedule of monitoring activities

The monitoring and observation process is on-going and is used to make management decisions on the farm.

Records have recently been transferred to a computer-based format, but farm diaries and paper records are still the major way records are kept.

Benefits & Costs

Chris feels that it is too early yet for him to accurately assess the benefits and costs of management changes. He has only operated the business for 3 years independently of the previous partnership.

One of the major benefits according to Chris has been the increased yields and profits associated with the changes. For example, the lupin yield has increased 1.2 to 2.0 tonne and there has been a three-fold increase in the carrying capacity for sheep. The tree lucerne has also enabled Chris to increase his cattle stocking rate to now run at least one cow and calf per hectare on what was formerly non-productive country.

He has noticed an improvement in his soil structure and any water that runs from the property is clear. The water table on farm has also dropped and the risk of salinisation is now lower.

Chris estimates the cost associated with the changes to be in the order of \$80 per hectare using contract labour and equipment. However, this doesn’t include fencing.

Case studies – Western Australia

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But he is quick to add that the farm environment would have been the real loser had he not made the changes. In terms of time, the changes have taken over three years to complete.

The Future

Chris is particularly interested in the prospects of any marketing opportunities that may come his way, as a result of implementing an EMS. For example, in the past, Chris' customers from Holland were interested in the farming system that produce had come from Chris expects this trend to grow in the future.

Chris believes that there will be more emphasis on farm planning in the future, as ill-informed decisions can cost dearly and it is very easy to get caught up in the euphoria of being short-sighted.

But at the end of the day, Chris believes there will need to be a balance between government and industry researching into Best Management Practices and ultimately coming back to grower groups to implement these.

Case studies – Western Australia

- Guyescliffe
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Authors:
Chris Cole and
Genevieve Carruthers

Roadside – the Giblett dairy

Paving the way for a healthier soil and dairy herd in WA

Wesley and Pauline Giblett



Roadside is 18km from
Bridgetown in WA

The Giblett family are the only biodynamic dairy farmers in Western Australia and have adopted a holistic approach to producing milk from their dairy cows. Wesley Giblett believes that biodynamics is a very good starting point into a more sustainable operation and in cleaning up the environment. The Giblett's family vision is:

"To leave the environment in better condition for their children, in hope that they will continue to farm the same way."

Wesley and Pauline are very enthusiastic about the environment and have organised several field days to demonstrate to other producers the principles of biodynamics. To this end the Giblett family are involved in local community environmental associations, as well as members of the Biodynamic Research Institute.

The Farm

The Giblett family owns and operates around 335 ha near Bridgetown, 400 km south of Perth in the Blackwood valley region of Western Australia.

Situated 280 metres above sea level, the farm is undulating to hilly and enjoys an average annual rainfall of around 750 – 800 mm, falling mainly from May to October.

The farm was first cleared of jarrah and marri trees in the early 1900s. Only around 10% of the land was left uncleared. Since taking over the farm, the Giblett family have been planting Sydney blue gums and numerous other species on the farm. Pine and blue gum plantations that cover approximately 5,000 ha also surround the farm.

The farm infrastructure comprises one house, shearing, dairy, machinery and two hay sheds and a general purpose shed.

Soil types on the property range from granite to loam with quartz rock scattered throughout.

Enterprises on the farm are dairying and beef, with beef slowly declining due to greater emphasis towards dairy farming.

The Family

The Giblett family settled in the area in 1908 when Wesley's grandfather started farming. Wesley is a third-generation farmer and runs 'Roadside' with his wife Pauline, their daughter Nancy and sons Lindsay and Brendan.



Blue gum plantation planted by
Wesley about 15 years ago

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With secondary school education, Wesley has been farming for 40 years and believes that it has only been in the last six years, since adopting the biodynamic approach, that he has really begun to understand the whole system.

The farm generates most of its income from dairying (60%) and cattle (30%) with Wesley doing contract hay-making (10%) during the season.

The Giblett family aim to:

- make biodynamics work so that others are encouraged to adopt the practices
- improve soil health
- adopt a holistic approach to managing the environment.

With this in mind the Giblett family aim to continue farming with minimal impact on the environment.

The Environmental Management Program (EMP)

The Giblett family began to farm biodynamically six years ago while they were running sheep and beef. Wesley and Pauline have always had a passion for the environment and this has grown even stronger since changing to biodynamic farming.

However, change had been coming for a long time, according to Wesley. *“The cost of single superphosphate kept going up and my returns were decreasing”*. He says that while he had lots of dollars going into the business he was still losing soil, water and nutrients.

“To make the changes, you have to be self-driven and make every winner a guide post, not a hitching post”, says Wesley. *“Don’t lose sight of the bigger picture; be prepared to step outside the paradigm”*, are just a few of the mottos Wesley believes in applying if you really want to make change work.

The main environmental issues for the Giblett family are:

- soil erosion
- water infiltration
- biodiversity
- native vegetation.

Because of the topography and creeks running through the farm, management of soil and nutrients is critical. With the adoption of biodynamics the Giblett family believe they are conserving their most precious resource base: soil. The basis for biodynamic farming is built on improving soil health. To achieve this on his farm, Wesley uses ‘Preparation 500’, a biodynamic preparation that is mixed with water and applied to the soil using specialised equipment. The mixture contains microorganisms, worm eggs and other elements, which begins the process of soil healing, according to Wesley.



Entrance to Roadside

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Dairy cattle grazing pastures, with blue gum plantation in the back ground.

In keeping with the philosophy of biodynamics, all cows on the farm are treated homoeopathically rather than with conventional drug treatments and, according to the Giblets, should have a lifespan far exceeding the average dairy cow.

In conjunction with the reduction of grain feeding and the subsequent increased use of pasture, the Giblets have moved to having cows calving during winter. Although this means they don't receive the summer milk prices now, Wesley believes that this loss of income is far outweighed by the lower-priced feeding regime.

Monitoring

Wesley notes that *“With dairy farming, you have the advantage of constantly being able to monitor on a daily basis the cows and paddocks they are grazing in”*. To ensure their approach is working, the Giblets have a monitoring program in place. Items monitored are shown below.

ITEM	HOW OFTEN
Soil tilth	Quarterly
Soil temperature	Quarterly
Soil smell	Daily
Native vegetation	Ongoing
Animal health	Daily

Schedule of monitoring activities



Wesley feeding dairy calves in what used to be old sheep yards

The results of monitoring are used to make management decisions, with a farm plan used to determine the direction. Wesley believes he is starting to see some of his goals achieved by change in soil condition on the farm.

Wesley believes that by using the biodynamic approach you begin to farm by “feel” and become more intuitive.

Benefits and Costs

The care being taken of the soil resource at Roadside is starting to become evident. Wesley says that where he used to have only 50 mm of topsoil, he now has 100 mm, with another 200 mm of soil ‘in transition’. He believes that the improving soil health is reflected in the health of his herds.

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The biodynamic approach has also saved considerable money in terms of inputs. Wesley used to spend over \$25,000 a year on artificial fertiliser. The biodynamic preparations he now uses cost around \$2000 per year (\$7 per hectare). Additionally, he now only applies the preparations if soil tests indicate a need for them.

Soil tests for Roadside cost \$180 each. Wesley takes separate soil tests annually for each of the soil types on the farm. The savings in fertiliser costs far outweigh the sampling costs.

The dairy is currently QA certified. The audits cost approximately \$ 300 per year for certification. The biodynamic audits cost a further \$130 per year.

Apart from the soil and animal health benefits, Wesley is quick to point out the tremendous gain in personal knowledge. *“Be prepared to accept the benefits as they occur, rather than expect them to happen”*.

Wesley also expects to gain a marketing advantage. *“As soon as I can use the DEMETER label, I’ll have world-wide recognition”*, he says.

New markets are in the offing for the produce from Wesley’s farm, with a Melbourne restaurant and a German customer both expressing interest in certified produce.

The Future

The Giblets will continue to work with the environment to ensure their farm is sustainable into the 21st century.

There is the expectation of a manufacturer in the near future buying their milk for the organic market. With the introduction of deregulation it makes perfect sense to Wesley to be able to market his milk differently. Currently the Giblets’ milk is sold to Peters Brownes Group and is swallowed up with the general supply.

One manufacturer in WA is looking at processing organic milk. Supplies for organic milk (which currently sells for \$2.50 per litre) are currently sourced from Victoria. The Cloverdene Company will take all the milk from Wesley’s farm if it has been certified ‘biodynamic’. Such milk currently can fill a demand for a niche market. There is evidence from overseas suggesting that one American organic milk company has doubled its growth in the past three years as a result of strong commitment from dairy farmers wanting to corner a niche market.

Wesley predicts that, in the future, ‘clean and green’ will form the image of the dairy industry and that in the next ten years, at least one of the major WA manufacturers will insist all milk supplies be organic. Wesley believes that his management approach has positioned him to take advantage of this situation when it develops.

Case studies – Western Australia

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- Wandalup Farm

Authors:
Chris Cole and
Genevieve Carruthers

Maybenup

Holistic approach for beef production

Jim and Pam McGregor



Ardcairnie Angus Stud is operated near Kojonup in WA.

The McGregors are first to admit they are quite ‘green’ when it comes to managing the environment. They have adopted Holistic Resource Management (HRM) to manage all aspects of their farm, including the farm environment. Both Jim and Pam are from farming backgrounds in Scotland and according to them, it’s possibly this experience that drives them to wanting to manage the environment in a more sustainable manner. The McGregors’ vision is to:

“Leave the farm in better health, if not for their children, then maybe for others“

Both Jim and Pam are enthusiastic about conserving the environment for future generations and are actively involved in local community environmental associations and committees. Jim was also instrumental in establishing the West Mt. Baker Landcare District.

The Farm



Entrance to the property

The McGregors only recently bought their new 1417 ha property, ‘Maybenup’ in March 1998, having previously run their Ardcairnie Angus stud at Denbarker for many years. They now run their Angus stud and commercial beef cattle enterprise of 400 breeders and some 2500 sheep for wool near Kojonup, approximately 300km south east of Perth in Western Australia.

With the farm generating most of its income from beef (77%) Jim and Pam are very focused on implementing a system that has minimal impact on the environment and on receiving adequate rewards for the quality of their product. Wool accounts for the balance of income.

Major Bruce first established the property in 1854. It is situated 320 metres above sea level and has an average annual rainfall of 500 mm falling between May and October. Soil types on the farm range from red loams to sandy soils. The underlying parent materials are granite and dolerite.

The topography is undulating, with native vegetation consisting of red and white gums, jam, and jarrah trees. There is very little native vegetation in the areas surrounding the farm. Shelterbelts of native trees have been established on the farm.

There are 8 creeks on the property and many drain into the 16 dams on the farm. Infrastructure includes two sets of cattle and sheep yards, a house, and machinery, hay and shearing sheds.

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The Family

As a couple Jim and Pam have been farming for 27 years since arriving in Australia from Scotland. Between them they have over seventy years' farming experience. Jim has a Scottish diploma in agriculture and dairying, whilst Pam was a former physical education teacher with a diploma in physical education.

Haven taken over the farm from previous owners in March 1998, the McGregors decided to switch to HRM as a fresh start towards their quest for a sustainable and regenerative system for managing the farm and the environment. Jim and Pam now farm 'Maybenup' by themselves, as their son has left the farm.

Together they have attended numerous marketing and farm-planning courses and the Holistic Resource Management course. Pam is a member of the WA Farmers Federation and both are members of the Beef Improvement Association and the Angus Society at the state level.

The McGregors aim to encourage plant biodiversity by getting their grazing management right. With this in mind they try to carry out their beef and sheep production activities with minimal impact on the environment.

They are in the process of implementing a QA program and SQF 1000 for their beef production program. They are presently involved with a pilot project of marketing certified branded Angus beef.

The Environmental Management Program (EMP)

Jim and Pam recognised some time ago that their previous grazing system of set stocking and annual pastures was very fragile. Changes in wool prices also influenced their decision to adopt a holistic view of not only managing their farm, but also marketing. They read of the work of Alan Savory and decided that HRM could work for them, too.

The McGregors adopted the HRM strategy because they believe this system enabled them to better manage the environment, as a consequence of the continual monitoring required. The sequence of HRM 'plan – monitor – control – replan' is very similar to that used in the ISO 14001 EMS process – 'plan – do – check – act'.

For Jim and Pam, the program initially started with the water cycle and maintaining ground cover, in an attempt to capture all the rain that falls and turn it into valuable feed. *"But to effectively do this you have to change your pasture composition"*, says Jim. This is one area he is currently addressing. Over time, however, Jim and Pam have begun to take a more inclusive approach to management. *"It's more than just using or controlling water; now we look at organic matter, fertilisers and minerals and also rural communities and how they work"*, says Jim.

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Since taking over the farm, the McGregors say that there are now more grasses and groundcovers, and that they have increased the stocking rate. They decided not to move into cropping so that they could concentrate on, and better manage, their cattle and sheep enterprises. The higher level of inputs required by cropping was another factor that helped Pam and Jim decide against that enterprise.



Jim inspecting perennial pastures

Recognising that sheep have a greater potential to damage the land, Jim and Pam have made use of temporary internal fencing, to allow them to better manage their stock. The temporary fencing allows Jim and Pam to move stock around more frequently, without the need for extensive re-fencing of the whole farm. In general, the flocks are managed to maintain a high proportion of young ewes, with wethers sold.

The McGregors see their success depending on biodiversity of plant species within pastures and are trying to create their own microbial biodiversity within the soil, via recycling of nutrients rather than relying on fertilisers or chemicals.

The main environmental issues for the McGregors are:

- biodiversity
- perennial pastures
- maintaining ground covers to prevent soil erosion
- ecosystem management
- maintenance of production levels over time.

In terms of ground cover maintenance, the McGregors have set the target of having at least 70% ground cover at all times, but with the intention of keeping closer to 100% where possible.

They have built on the Cattlecure and SQF programs in developing the EMP. Jim says he has been applying best management practices for his whole time as a farmer but now is writing down more of what he does. He is currently adopting a QA program (*“because it is required by Meat Standards Australia”*) and the SQF program (*“it relates to the whole enterprise”*). He plans to move to an EMS in the future. Jim feels that it is only commonsense to integrate QA, occupational health and safety and environmental management under the one program. In part he feels that integration would make people question what might be considered a best management practice that may not actually be sustainable.

Monitoring

The McGregors’ monitoring system is based on the HRM program where paddock assessments take place over a period of time but, according to Jim and Pam, the next logical step for them is to incorporate an EMS in their farm management.

Transects are used, to aid monitoring, with photographs used to record changes.

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ITEM	HOW OFTEN
Vegetation cover	Transects sampled periodically, 100 random point in transect sampled
Soil insects and other fauna	Transects sampled periodically, 100 random point in transect sampled
Erosion	Transects sampled periodically, 100 random point in transect sampled
Plant spacing and species mix	Transects sampled periodically, 100 random point in transect sampled
Seedling regrowth	Transects sampled periodically, 100 random point in transect sampled

Schedule of monitoring activities

Monitoring results are built into management all the time but there is no formal review held. If one aspect of the farm management appears not to be going to plan, the more monitoring is developed to keep a closer track of the issue.

Records on the farm are kept on paper, and increasing use is made of a 'Cash Book' program on the computer for financial records. Jim and Pam plan to introduce the program "Herd Magic" next year. By using the Cash Book program, Pam and Jim believe it will be easier in the future to keep track of costs associated with management, something that is difficult to do at present.

Benefits and Costs

Jim and Pam say that at present it is difficult to accurately work out the financial benefits of the changes they have made. Many of the changes have been in areas other than those that can be given a dollar value.

By using HRM, the McGregors are more focused on their management and have a clearer direction as to where they are going with management issues on-farm. They feel more confident in their management. There have been unexpected benefits, too. For example, Jim and Pam feel that they now talk to each other, discussing their progress.

The environment is benefiting in the long term. The McGregors say that with better ground cover, they have reduced erosion and surface water run-off and increased stocking rates. In July 2000, the McGregors had a stocking rate of 7 DSE per hectare.

The soil is becoming more friable due to increased organic matter from increased litter and nutrient recycling in the paddocks.

Jim and Pam are very confident that the changes they have made on their farm help them keep costs down and produce what the markets want (clean and green products). The overall industry trend towards more sustainable farming approaches is seen as a very positive step by the McGregors.

Their belief in their system was reinforced recently when neighbours and others commented on how well their property looked following the dry spring experienced in 2000, when surrounding properties were bare and hand-feeding of stock was

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required. Jim and Pam have identified improved stock health as one of the benefits for their farm.

Adopting a new management system comes at a cost, with infrastructure having to be put in place. For the McGregors, this has meant temporary electric fencing, water troughs, tanks and pumps. The initial cost of the HRM course itself also needs to be included. Jim estimates that installing the tanks and pipes required for improved water management took roughly a full week in each of two years.

Jim and Pam both feel that there has been an increase in the time required to manage the property – moving stock more frequently, for example, has required more time. They expect that these costs will continue until the HRM approach is fully in place. There are also added costs in time associated with increased monitoring, but both Jim and Pam believe if the stock are doing better, then so too are the land and environment.

Funding was received from the Natural Heritage Trust for the establishment of tree belts and protection of the remnant vegetation on-farm.

Jim and Pam employed a consultant to help them develop their approach, and have also worked with the Kojonup farm management group in developing the HRM work.

The Future

By improving on what they are currently doing, Jim and Pam believe they are making progress towards their goals of a sustainable resource base and this will help balance both the financial and production side of their business. They hope, with the aid of Breedplan and MSA, to be an accredited supplier of beef to various markets.

“More use could be made of the various ‘credit’ schemes that have been proposed to encourage farmers to adopt improved practices”, say Jim and Pam. Tax rebates and training subsidies are also ways of providing encouragement.

They believe it will only be a matter of time before the consumer will insist on better environmental management and accept there are costs involved. *“Ultimately, the consumer will dictate what environment we end up with”.* Jim and Pam hope that through preferentially purchasing products that are demonstrably ‘clean and green’, consumers can assist farmers meet the environmental aspirations of the community.

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Payneham Vale – Producing healthy food without destroying the environment

Authors:
Chris Cole and
Genevieve Carruthers

Ron and Susan Watkins

According to Ron Watkins it didn't take him long to recognise that on his farm, water was not only the root of the salinity problem, but an untapped resource. When tackling a problem, Ron doesn't think in one dimension, or even three, it's more like ten or twelve. Ron's motivation can be summed up thus:

"A good man leaves his inheritance to his children's children".

To make this vision become reality, Ron has adopted the concept of integrated whole farm planning, which has seen him win several major environmental awards including the prestigious United Nations Environment Program (UNEP) Global 500 Award.

At the time of interview, Ron was the president of the Land Management Society. He conducts farm tours frequently through his property demonstrating his concepts of biodiversity management.



Ron Watkins' farm is near Frankland, WA.

The Farm

The property Payneham Vale is located approximately 350 km south - south east of Perth near Frankland in Western Australia.

The property has an average slope of 6 % and an altitude of 300 metres above sea level.

The mixed farm is 552 ha, with infrastructure comprising two houses, two large dams (30 & 25 megalitres) plus other smaller dams, machinery, hay and shearing sheds.

It has an average annual rainfall of approximately 580 mm, which is received predominantly from May to October via north-west frontal systems.

The original vegetation consists of white gum, (*Eucalyptus wandoo*) red gum (*E. callophylla*) and Jarrah (*E. marginata*). Plantings over the last 20 years have consisted of 37 different tree and shrub species. Around 25 % of the farm is covered in trees of which 15% is native bush that has been fenced off or is in the process of being fenced and 10 % is planted tree belts.

The predominant soil type is a duplex sandy gravel loam over clay, with granite, quartz and dolerite intrusions. There is one main creek on the farm, with other smaller drainages.



Trees planted on contour drains used to run water into dams on the property

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Labels and packaging used on the farm

Historically, enterprises on the farm were wool (75 %) and cattle (25 %). Now, cropping on the farm includes canola on 40 ha, oats and lupins, with beef cattle, wool sheep and prime lamb enterprises. Pastures are a mixture of improved sub clover and annual rye grasses. There is also increasing organic horticultural production emerging with plantings of carrots, onions, potatoes, olives and chillies. Recently the Watkins became NASAA certified for their organic produce as the farm now generates most of its income (50%) from organic horticulture, with crops (15%), sheep (20%), and cattle (15%) making up the remainder.

The Family

The farm has been in the Watkins family since Ron's grandfather first began clearing the block in 1908.

Following his graduation from Curtin University with a Diploma in Agriculture, Ron has been farming for 27 years and has devised his own farm plan as a result his years of experience.



The tree lines on-farm provide areas of habitat for predatory insects and many species of birds.

Ron took over 'Payneham Vale' in 1973 with his wife Suzanne. Their son, Bradley, and his wife Lynne now also farm there. Seventeen years ago Ron began doing consultancy work for other farmers as a result of the developments on his own farm.

The Watkins have established their own web page and market 'Payneham Vale Organics' produce into the domestic market.

Their passion for environmental protection and sustainable production has lead them to many initiatives in the area of integrated pest management. For example, they use the shelterbelts of trees as attractants for native birds, which then eat the insects in crops.

The Environmental Management Program (EMP)

Ron took over the farm in 1973 and a few years later noticed the salinity level in the home dam that had watered his mother's vegetable garden since 1951 was reaching detrimental levels. This prompted Ron to embark on his process of integrated whole-farm planning. Other drivers to adopt change were the declining prices gained for wool, increasing costs of fertilisers and the need for equipment to apply fertilisers. Ron realised that his management and the farm's operation needed to change.

Ron began by redesigning his farm's layout to control and harvest surface and subsoil water flow to improve soil structure and create a large volume of stored water. "None

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of the paddocks are the same as they used to be; all of the areas of use have altered with time”, Ron notes.

Since 1982 Ron has built 16 km of drains to connect dams on his property. The positioning of the drains is determined by what Ron calls ‘significant landscape features’. Drains are planted with up to 1000 trees per km in belts four wide protected by electric fencing. In the future, these belts will be six trees wide.

According to Ron, management is “a real balancing act: you don’t want to prioritise one feature of the environment against the others, as these change over time. For example, it might be wind erosion some years, water logging others. You need to try to set up factors that balance all the major impacts”.

While he has no formal or written environmental policy, Ron believes in the integrated whole-farm planning approach to address environmental issues. What Ron is trying to do is to manage a living ecosystem. He recognises that this may take many years to achieve.

According to Ron, he is endeavouring to work within, and not at the expense of, the ecosystem. A truly sustainable farming system must improve and then maintain the health and vitality of the ecosystem. Ron says that there are some very clear signals to farmers indicating that consumers want environmentally friendly produce. *“A speaker from Sainsbury’s spoke at the EMS workshop in Ballina in 1999, and pointed out that in some countries farmers are being paid to adopt organic production methods”.* Ron believes that such demands will increase in the future.



Run-off water stored in dams on the farm is used to irrigate organic vegetables.

Monitoring

In an attempt to monitor environmental health and thus the sustainability of farm practices, Ron uses 14 indicators.

Ron played a part in the development of the Farm Monitoring Kit through the Land Management Society of Western Australia. The kit aims to offer the farmer a set of simple tests that build a database of environmental indicators that can be monitored over time.

The kit provides a simple set of indicators that can be easily assessed on farms. The monitoring calendar is a good reminder for farmers of the need for monitoring, to help them manage their farms. The indicators used provide a combination of both environmental and production factors.

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ITEM	HOW OFTEN
Water table depth and salinity	Monthly
Soil Salinity	Annually in dry season
pH of soil	Annually in dry season
Rainfall	Event-based recording
Winds	Event-based recording
Frost	Event-based recording
Sheet erosion	Monthly
Stream – volume and salinity	Monthly in winter only
Dams salinity	Annually in dry season
Soil water repellence	Annually in dry season
Infiltration rate	Annually in wet season
Soil Compaction	Annually in wet season
Ground Cover	Annually in dry season
Earth Worms	Annually in wet season
Soil structural instability	Annually in dry season
Vegetation yields	At output period
Crop yields	At output period

Schedule of monitoring activities

Monitoring results are reviewed on a monthly basis. Records are kept in farm diaries and other paper-based formats and on computer. Ron believes that monitoring makes it easier to assess the benefits of changed practices.

One of the success stories of monitoring has been the documenting of the bird species on the farm. Bird banders look forward to their time on Payneham Vale because “*there are so many birds*” says Ron.

Benefits and Costs

According to the Watkins, the environment is part of the overall management of the system that Ron has and is continuing to develop. Ron believes that the changes implemented on the farm had to be made in order to maintain a viable farming operation in the area.

The impact of tree planting has been considerable. Ron states whilst riding on the back of a truck one winter’s day he could appreciate how much protection the tree belts gave to stock and crops. Improved stock and crop health are seen as two of the benefits of his farm management approach.

Ron currently collects about 50 megalitres of water each year, which previously ran off the farm. He believes there is the potential to collect about 300 megalitres. Controlling water has led to reduced water-logging while the increased water storage provides Ron with three hectares of irrigated crops and plentiful supplies of stock water over the summer months. Ron estimates that the waterlogging problem has been improved by around 70% on original levels. As a further benefit, the vast area of trees, dams and drains not only protect and improve current enterprises but have opened up a whole array of new farm activities (organic irrigated vegetables).



Ron checking piezometers as part of water table monitoring on the farm

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The work Ron has done on 'Payneham Vale' has received considerable attention. Apart from the 1995 UNEP award, Ron also won the Rural Achiever of the Year Award in 1995, the inaugural UN 'Saving the Drylands' award, and a national Environment Department Award (also in 1995). He conducts monthly farm tours, has been invited to speak at many meetings and conferences and has been interviewed for several television programs. He finds farm tours are the best means of exchanging information.

Other areas that Ron believes are benefits are reduced risks and liabilities, ease of meeting legislative and licence requirements, increasing biodiversity and improved market access (the latter being due to his organic certification). He also feels that he is much more confident in his management overall.

Ron maintains that it is too difficult to put an accurate figure on the costs associated with the changes, on what he believes had to be done when it comes to the environment. He further adds that in many cases, economic constraints drive farmers to use unsustainable practices.

The Future

Ron believes that with the changes he has made to the farm layout, he will gradually be able to develop other enterprises on the farm such as aquaculture and more irrigated crops. Future tree lines could be planted with a variety of higher-value timber and fodder species. The increasing number of farm visitors has also opened the door to the growing industry of eco-tourism.

Ron would like to see more research support for farmers who are attempting to implement innovative measures to address environmental issues. *"Tax deductions could be linked to monitoring programs"*. Ron suggests.

Industry groups also need to take more of a leadership role in the future. Ron believes that governments should be more supportive of proactive farmers. He feels that regulation is likely to limit improved environmental management, as it stifles innovation.

The Watkins are seeking to supply agricultural products that have been produced with due care for the environment. Ron believes that, in the future, consumers will



New beds prepared for planting of organically produced vegetables



Ron uses these containers for cold-storage of organic produce, prior to shipping it off the farm.

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have a huge impact through their purchasing power and that they will demand more accountability in farm practices. The use of the Land Management Society monitoring kit is one way farmers can have the data to verify their claims of responsible management. The certification process Ron has undertaken with his organic production is seen as a good way to provide accountability.

Ron believes that his farm could sustain two or three more families and sees this approach as one way to sustain rural communities. *“We need more people on this country to look after it properly”* says Ron. *“We want to make more use of what we have got here.”*

According to Ron, *“you have to look at diversity and a stable ecosystem is a diverse ecosystem.”* Ron is striving to maintain and build on that diversity now and into the future.

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Wandalup Farms

Piggery becomes a nett user of piggery waste

Rob Wilson

Wandalup Farms' general manager Rob Wilson recognised some time ago that to address community concerns and perceptions about the impact of piggeries on the environment, the industry would have to be pro-active in waste management. To remain profitable and sustainable, the Wandalup piggery had to adopt a waste management strategy that would enhance the environment both now and into the future.

Wandalup Farms' environmental policy aims to:

"Recycle and integrate all of their operations on the farm, so they become a nett user of waste"

According to Rob, the farm has nearly reached its goal of integrating the piggery operation with that of the recycling composting operation.

But Rob maintains the piggery will have to stay abreast of environmental issues to maintain viability in the future, due to continual community concerns about the environment and increased urban encroachment on the farm. Odour management in particular will need to be addressed in the future.

The Farm

Wandalup Farms is a 400 ha property situated on the Swan Coastal Plain, 80 km south of Perth in Western Australia. The farm is part of the George Watson Food Ltd, (Watsonia) business group.

Formerly operated as a grazing property running beef cattle, it was purchased in 1978 / 79 and has now been developed into a modern day piggery operation. The piggery enterprise consists of a 2,000 sow farrow-to-finishing operation, giving a total pig population of 22,000. The other major enterprise is the composting operation known as 'Custom Composts'. There is also a commercial 40 ha market garden on the farm. About 95% of the income is derived from the piggery operation, with compost contributing 3%. The final 2% comes from timber sales.

The infrastructure on the farm consists of one each of farrowing and grower sheds, two dry-sow and two finishing sheds and eight eco-huts for pig production. Two hay sheds, two houses, two offices and a workshop are also located on the farm. Five effluent ponds contain effluent from pig production.

The soils on the property are predominantly deep, highly leached Bassendean sands, overlaying clayey sands at depths greater than 8 metres. These soils have a poor ability

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Wandalup Farms is located near North Dandalup, WA.



Entrance to Wandalup Farms

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Eco-huts used to house 250 grower pigs. The used bedding straw provides a carbon source for the composting operation.

to absorb phosphorus. Nutrient leaching is a recognised problem in the area.

The region is recognised for problems associated with nutrient-rich runoff and eutrophication of rivers and waterways. The Serpentine river, which forms part of the Peel-Harvey estuary, is only 3 km away so Wandalup Farms had to make sure that its piggery operations do not impact negatively on the health of the estuarine system. With many dairy and cattle farms in the area, the run-off into the Serpentine River is of concern for the whole community.

The farm has a Tasmanian blue gum plantation comprising approximately 180,000 trees. There are a number of swamp areas and a man-made drain to the nearby Serpentine Creek. A number of houses are close to the farm and there is an airstrip nearby.

Wandalup Farms has a QA system in place for its piggery, composting and feed supply operations. Markets for farm produce include the domestic pork and small goods markets and there is some exporting to Singapore. Quality assured chilled pork is marketed to Japan.

The Staff

Rob Wilson has been involved with the intensive livestock industry for thirty years. Rob holds a Bachelor of Science degree, a PhD in Agriculture and a Masters of Business Management. Rob is responsible for a wide range of staff, including technical, production and operation managers. Rob is involved with the pork industry Research and Development Corporation.

The farm is also involved with the University of WA and Murdoch University agricultural programs.



The primary screening area for effluent

The Environmental Management Program (EMP)

Wandalup Farms already had a waste management system in place for many years that dealt with the use of treated effluent, flood-irrigated onto pastures and native wetlands on the farm.

However, in response to increased public and regulatory concerns about nutrient run-off into the river and estuary, as well as part of the licencing agreement with the EPA, a decision was made to upgrade the environmental plan with the implementation of a composting plant and

recycling operation. Having an existing environmental plan meant it was easier to further develop the EMP.

The composting plant and recycling operation that were developed were

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revolutionary in Australia at the time and similar plants are now being built in Australia and overseas. The quality of the recycled water is now high enough to be re-used as flushing water throughout the piggery sheds.

The main environmental issues for Wandalup Farms are:

- phosphorus and nitrogen management on and off the farm
- the improvement of waste water by using physical / chemical technology
- enhancing solids capture
- recycling of treated waste water for flushing
- algal blooms and high N and P levels in the estuarine environment.



The TFS set-up, an integral part of the composting operation

For Wandalup Farms, the long-term target is to produce a low nett phosphorus export from the farm of 1.5 kg P per ha per year.

To do this, Wandalup Farms invested in a Tangential Flow Separator (TFS) as a physico-chemical method of removing phosphorus from its wastewater stream. Some 750 kL per day of raw effluent is screened to remove coarse solids before being fed to the TFS. The water is then further cleaned. The majority of the water used on the farm each day is now supplied by this recycling process.

The integrated piggery and composting operation recycles in excess of 50, 000 tonnes (100,000 cubic metres) of mostly wet organic waste material on a continuous, sustainable basis each year. This material would create a significant problem for conventional landfill sites.

Composted materials are not only being diverted from landfill, they are also converted into materials that will play a significant role in the future sustainability of the region's farming system, by adding valuable organic matter to the soil.



Compost piles in various stages of preparation

Staff on the farm made many of the changes, but a consultant was used to provide assistance with some of the technical changes.

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Monitoring

A key component of the environmental plan is monitoring. Wandalup Farms produces annual environmental reports as part of EPA requirements.

ITEM	HOW OFTEN
Nutrients - N & P	Samples are taken and sent to accredited laboratory for analysis - weekly, monthly or 3-monthly, depending on issue
Overall water use	Flow meters on bores, results tabulated on 6-monthly intervals
Bores	Every three months
Treatment systems	Monthly
Water leaving property	Weekly

Schedule of monitoring activities

Monitoring results are tabulated on a yearly basis. A combination of records is kept, including paper and computer records, and laboratory reports. Flow rates of water are automatically loaded onto the computer.

Rob says that the discipline of having to keep records means that it will be easier to assess the real costs of management changes in the future.



The 'Custom Compost' area on the farm

Benefits and Costs

Effluent management started out as an environmental problem for Wandalup Farms but with innovation and good management, the problem has been turned into a full-cost recovery operation, with 'Custom Composts' now manufacturing growing medium for the commercial production of mushrooms.

The market garden on the farm now uses the recycled water for irrigation. Previously, the farm used large volumes of ground water in its piggery operation. Through the use of recycled waters, the demand on ground waters has been reduced dramatically.

Over the years Rob has worked hard to forge good community and industry relationships on environmental matters, which has been quite effective. Recognition for the work being done on Wandalup farms has come in the form of their winning a State recycling award.

However, there are still some community concerns, mainly from those who do not know the history of the farm. These issues will have to be addressed in the future.

Rob feels that the overall risks and liabilities of the business have now been reduced. It is now much easier to meet licence requirements. There is a commitment by the company to the environment and now Rob has to regularly report on environmental issues.

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Initially the composting operation cost \$1.6 million to set up, with on-going monitoring costs of \$ 4,000 per year. The composting and recycling operations, as part of the environmental management plan, have running costs of around 4 cents per kg of pork produced. These costs mean that the changes made have not allowed for a nett financial gain so far.

But there has been a positive impact on environmental performance and community acceptance of the business. According to Rob, had the company not decided to do something positive towards managing its waste, then ultimately closure of the farm would have been forced upon them and they would be left with a costly clean-up bill. Setting up the enterprise elsewhere would also have involved great cost.

The Future

Wandalup Farms has been an active participant in environmental issues for years. It has won State recycling awards and as an industry member, is now developing BMP and codes of practices.

There is some interest from McDonalds regarding environmental issues being addressed by the industry. The developing market for compost will allow the incorporation of more of the waste streams from the farm and other sources into environmentally beneficial end products. The goal is to eliminate Wandalup Farms as a potential point source of pollution to the Serpentine River and Peel-Harvey estuarine system.

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Shalloch

Meeting environmental challenges in New Zealand

Julie and Neil Hamilton

The New Zealand dairy industry is a major player in the world market accounting for 31% of dairy products traded.

Outside the European Union, New Zealand is the largest exporter of butter and the second largest exporter of cheese and milk powder. The main markets for New Zealand dairy products include Europe, the United Kingdom, Latin America and Asia.

Milk produced by dairy farms in New Zealand is supplied to dairy co-operatives. They then market all dairy product through the New Zealand Dairy Board (NZDB).

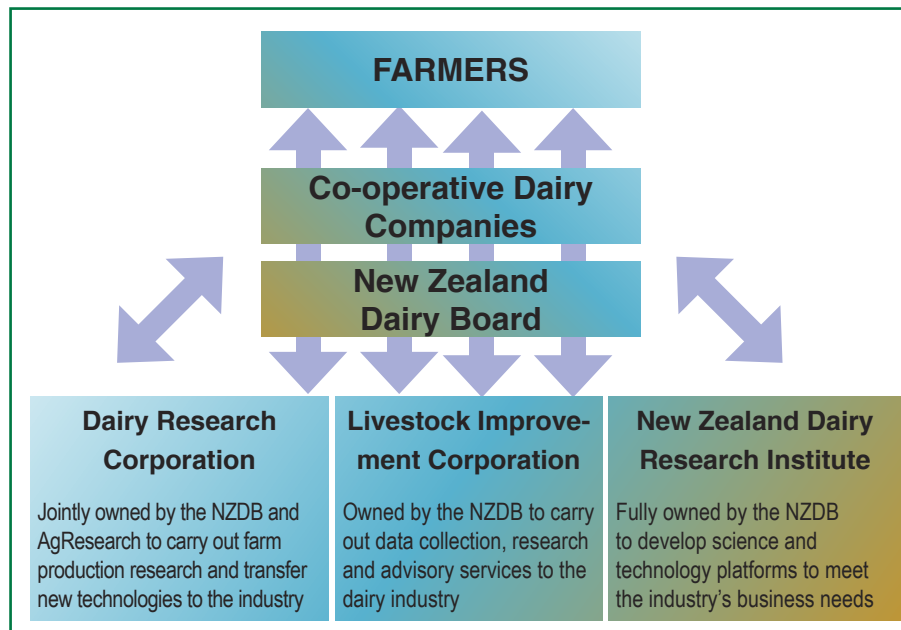
The NZDB is responsible for all marketing functions including:

- packaging
- shipping
- transport
- storage
- quality control, and
- promotion.

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Map of New Zealand showing the location of Oamaru



New Zealand dairy industry structure. Source: MAF



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The dairy herd on the Hamiltons' farm

Neil and Julie Hamilton are a proud part of the New Zealand dairy industry. They are also part of another group known as NOSLaM (North Otago Sustainable Land Management Group).

The group was established in the mid-1990s to promote sustainable land management practices in the North Otago region. Since then, not only has NOSLaM developed best management practices for a range of farming groups in the Otago region, including dairying, they have also introduced an Environmental Management System (EMS) to North Otago that is practical and easily adopted by farmers.

The system is known as *ENVIRO-AG*. It is based on ISO 14001, the internationally recognised standard for environmental management and uses Hazard Analysis and Critical Control Points (HACCP), the internationally recognised system for managing food safety to analyse environmental impact.

There are over 80 properties in Otago that operate under the *ENVIRO-AG* system and a small number of these have now been able to obtain ISO 14001 certification. Neil and Julie Hamilton's property near Oamaru is one of the farms that have had ISO 14001 in place for the last couple of years.

The Farm

The Hamiltons operate a 177 ha property called Shalloch not far from Oamaru. Neil and Julie purchased the farm 12 years ago in partnership with Neil's parents and brother.

Shalloch boasts 520 milking cows, 120 heifers and 159 yearling calves.

The soils are alluvial, with a silt loam top layer of around 50 to 60 centimetres. The farm is surrounded by other dairy farms, so the potential impacts of Shalloch's activities on the environment are echoed around the district.



The green paddocks of Shalloch

When they purchased Shalloch, it was a beef property. During the conversion from beef to dairy cattle, the Hamiltons made many improvements to the farm including:

- refencing
- reborder dyking
- re-grassing of paddocks
- tree planting
- drainage work.

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The Family and Staff

Neil has been farming all his life and Julie was brought up on a dairy, so it was natural for them to move into dairy farming.

Neil and Julie's ambition is not to be milking in their retirement, so they are planning and managing their farm to help them meet this goal.

Neil does a lot of the hands-on work on the farm and he has employed a farm manager to assist him with this. Additionally, the Hamiltons use the services of a farm adviser on a regular basis to help them with management planning and review.

Julie is involved with keeping many of the records for the farm and is an avid advocate of computer technology to help with farm management.

Both Neil and Julie have made a commitment to their farm. They want to:

"Make sure that when they leave the farm, it will be in better condition than when they bought it."

The Environmental Management System (EMS)

The Hamiltons have adopted ISO 14001 as the guide for their EMS. A consultant provided by the NOSLaM group took the Hamiltons through the process of analysing the impact their operations had on the environment. Some of the impacts Neil and Julie identified include:

- agrochemicals
- intensive grazing
- cultivation
- fuel storage
- irrigation
- pest management
- disposal of dead stock
- weeds, and
- effluent disposal.

The storage and use of agrochemicals needs to be managed correctly to ensure that soil and ground water contamination do not occur.

Intensive grazing of paddocks may result in soil compaction and overgrazing can result in a decrease in pasture species and a reversion to weeds. If cultivation is not managed correctly, soil erosion can occur and there is a risk of nutrients entering waterways.

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One of the irrigation channels on the Hamiltons' farm

Irrigation of farmland using dairy effluent must be managed with great care to ensure that excess nutrients are not applied. Because the Hamiltons depend on bore water for their household needs, they must ensure that they minimise the risk of leaching effluent into their water supply. Similarly, disposal of dead stock needs to be managed to ensure that there is no contamination of ground water.

Pests such as possums and ferrets are potential hosts for bovine tuberculosis and rabbits can

deplete natural vegetation resulting in soil erosion so the Hamiltons must ensure these pests do not reach excessive numbers. Weeds also need to be controlled so that desirable pasture species are maintained.

With all these impacts identified, Neil and Julie set about the task of developing strategies to manage these impacts so that they did not have a negative effect on the environment.

Surprisingly, very few changes needed to be made to the Hamiltons' operations as they had already implemented many strategies to manage these key issues. In fact, once they had identified the key environmental impacts, it took less than a week to make the changes that were required to ensure that their system complied with ISO 14001.

Neil and Julie increased the paddock area they irrigate with dairy effluent to ensure that excess nutrients are not applied to any one paddock and they installed locks to their chemical store. However, the biggest change that occurred was more attention to monitoring and recording of environmental indicators.

Monitoring

Soil tests are conducted annually and bore water quality is checked every 3 years. This monitoring gives Neil and Julie the confidence that their effluent management is going according to plan.

According to Julie, once they had identified the environmental impacts and developed the monitoring and recording system, most of the hard work was done.

The Hamiltons review their progress on a monthly basis and also have an annual review to meet ISO 14001 requirements.

Records are kept on computer, with an animal health program, Dairy Win, used as a stock management database.

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Benefits and Costs

The Hamiltons have derived considerable benefits from having implemented an EMS on their farm. Overall, they believe that their risks and liabilities have been reduced and they find it easier to meet legislative and licence requirements.

The health of their soil and their stock has improved because they are not applying excess nutrients to the soils. In the past, stock that grazed on effluent irrigated paddocks often developed mastitis but since the Hamiltons have started to spread their effluent over a wider area, this problem has improved dramatically.

Neil and Julie are also confident about their household water supply because they are keeping a close watch on its status via their EMS monitoring program.

The implementation of an EMS has also improved communication between the Hamiltons and their staff on the farm. The staff understand the importance of sound environmental management and take great pride in how they carry out their jobs on Shalloch. The response time of all staff to problems has been improved and contingency plans are now in place.

The EMS audits have been funded by the NOSLaM group and so far have not represented a cost to the Hamiltons. They recognise that this will change in the future and they will begin to pay for these audits themselves. NOSLaM also paid for the consultant who assisted in the EMS development.

While new locks had to be purchased for the chemical stores, these were really the only infrastructure changes required and as such were minimal.

Julie estimates that she only spends about one additional hour per week on the EMS and this is devoted to the monitoring work.

The Future

Julie and Neil say that while they recommend that others develop an EMS, each farm should be treated individually. *“Each farm is unique, so you must go through the process yourself – no-one can do it for you.”* They would like to see more industry support for such an approach in the future.

Neil and Julie are very confident about the dairying industry and their farm's future. Because they have undergone the process of analysing their environmental impact and determined what monitoring and recording needs to be done, they know that they are able to make better management decisions.

Although they don't receive a premium for their product because the farm has an EMS, the Hamiltons are sure that they face the future knowing they can provide their

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customers with the assurance that their dairy products are of high quality, safe, and produced in an environmentally sensitive way. They expect such demands to grow in the future and hope that customers will start to support responsible farmers through preferential purchasing of assured 'green' produce.

Shalloch is a farm that has taken a clear lead in the dairy industry in New Zealand by adopting a program that provides the proof to its customers that the farm is really 'clean and green'.

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Garamea

Evidence of environmental commitment

Owen and Judith Ruddenklau

Over the last few years, a progressive group of farmers in the South Island of New Zealand has adopted a practical environmental management scheme that allows it to demonstrate to the world that New Zealand farmers are truly environmentally conscious.

In 1994, key farmers from the North Otago region came together to form the North Otago Sustainable Land Management Group (NOSLaM). One of the first things that NOSLaM did was put together a set of sustainable land management practices for farmers in the region. Practices were developed for dairy farmers, pastoralists and market gardeners.

The group's vision was to have the majority of North Otago's farmers implementing sustainable land management practices that would be recognised at a national level.

Members of NOSLaM were so enthusiastic that in 1996, they were able to secure funding from the Ministry for the Environment to develop an Environmental Management System for farmers that was easy to use and maintain. As a result the *ENVIRO-AG* concept was born. *ENVIRO-AG* is based on ISO 14001, the internationally recognised standard for environmental management systems. It also utilises Hazard Analysis and Critical Control Points (HACCP), the internationally recognised system for managing food safety to analyse environmental impact.

There are over 80 properties in Otago that operate under the *ENVIRO-AG* system and a small number of these has obtained ISO 14001 certification. Owen and Judith Ruddenklau's property near Oamaru is one of the farms that has had ISO 14001 in place for the last couple of years.

The Farm

The Ruddenklau's operate a 192-hectare property called Garamea in the hills west of Oamaru. Owen's grandfather established the farm in 1920. Since that time the farm has been carved into smaller units. Owen, his brother and his father now operate these.

Owen and Judith run between 1500 to 2000 sheep on the property, as well as 30 to 40 cattle. Garamea produces beef cattle and wool for the local market.

The property faces northwest and is exposed to drying winds. The soils on the farm are light brown silt loams and the topography is classified as rolling to steep.

Authors:
Gioia Small and
Genevieve Carruthers



Map of New Zealand showing the location of Oamaru

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The steep slopes on the Ruddenklau farm



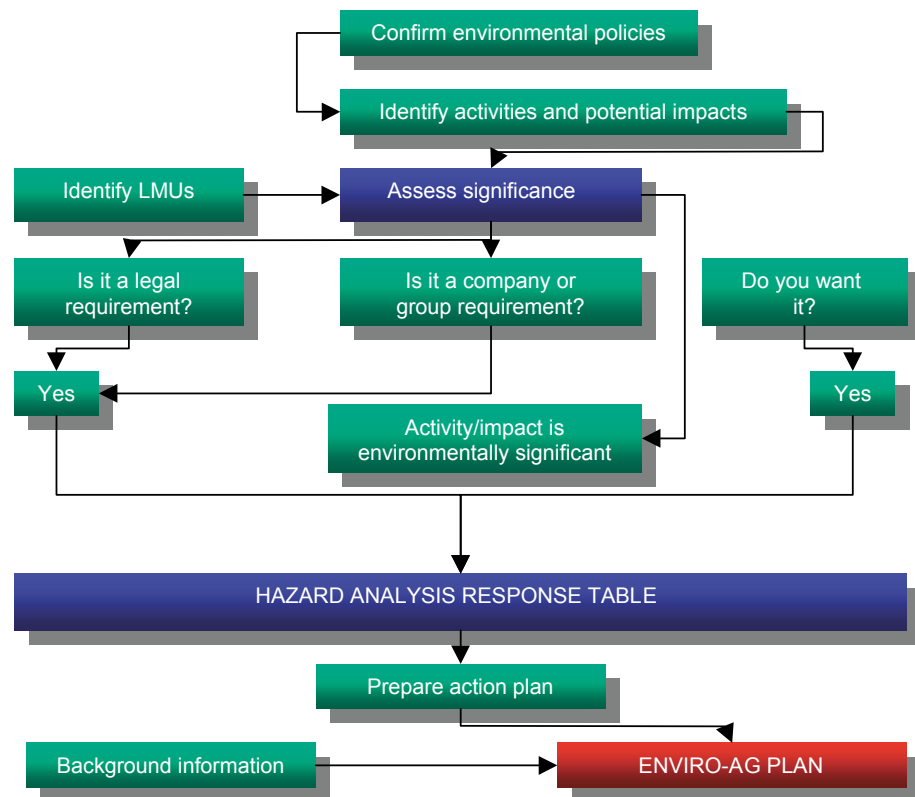
The paddock that 'blew' away

In the 1980s, Owen and Judith witnessed first hand how badly erosion can affect steep slopes. The Otago region had undergone a period of drought. When the drought broke strong winds and rain literally eroded tonnes of topsoil from one of the recently cultivated paddocks on Garamea. Devastated by this event, Owen realised that the traditional management practices that had been employed on the farm up until then had to change.

Since that event, Owen and Judith have:

- moved away from cultivation to direct drilling;
- use drought-tolerant species in their paddocks; and
- have adopted ISO 14001 as the standard for their EMS.

The paddock that 'blew' away is starting to recover and because of their EMS, the Ruddenklau have an effective way of managing and improving the environment on their farm.



Steps taken to develop the EMS. Source: ENVIRO-AG workshop manual

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The Family

Owen and Judith have been involved in farms all their lives, having worked in farming and contracting overseas as well. They have three children who are all involved in farming. Should the Ruddenklau children choose to continue the family farm, Owen and Judith want to make sure that the farm is left in the best condition possible.

The Environmental Management System (EMS)

A structured approach was used to develop the EMS. The previous figure highlights the major steps involved. The Ruddenklau started out by providing background information on the farm and the practices that they had in place. The farm was then divided into Land Management Units (LMUs) based on physical differences. As a result of this, Owen moved some of the fences on the farm to accommodate these LMUs.

Owen and Judith then sat down and wrote an environmental policy that clearly detailed what they stood for in terms of environmental management.

The next step was to document the activities that occurred on the farm and their potential impact on the environment. The table below highlights some of these activities.

With these potential impacts identified, the level of significance was determined using two key criteria; the likelihood of the impact occurring and the consequences of the impact.

ACTIVITIES	POTENTIAL IMPACTS
Cultivation for crop establishment or pasture renewal	Soil and nutrients entering watercourses Rill erosion Wind erosion Soil compaction Erosion on floodplain from flood waters
Herbicide use	Damage to plants on neighbouring property Adverse impacts on beneficial bugs around crops Adverse impacts on water quality
Grazing stock during prolonged drought conditions	Reversion to weeds and decreased pasture species Wind erosion

Source: ENVIRO-AG workshop manual *Farming activity and potential impact on the environment*

The likelihood of the impact occurring was based on:

- the intensity and scale of the activity
- the proximity of the activity to the resource that was ultimately being impacted upon
- the inherent susceptibility of the resource
- any mitigating factors.

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Activity	Impact, risk or hazard	Objectives/ Targets	Operational Controls	Monitoring	Location of recorded data	Corrective action
Agrochemical storage and handling	Environmental contamination	Avoid all forms of accidental contamination by leakage and spillage	Store in locked and bunded areas Follow Grow safe guidelines Provide staff training on handling of chemicals Don't store incompatible materials together	Record details of timing, application rates etc. of all chemicals used in specific paddocks Keep register of all stored chemicals Plan of storage shed layout	Monitoring data folder	Enlarge bunded area Review procedures for handling chemicals Store incompatible materials in a separate facility

Source: ENVIRO-AG workshop manual
HART chart for agrochemical storage and handling

When considering the consequences an activity had on the environment, a scale was used ranging from no impact through to severe impact. An impact was considered severe if it took several seasons to repair the damage caused.

All the impacts were then summarised on a Hazard Analysis Response Table (HART). An example of an analysis for agrochemical storage and handling is provided in the HART above. With the HART finalised for each area of significant impact, the Ruddenklaus were then able to write up an action plan of all the things they needed to do to make their EMS work.

Environmental improvement is also a big part of the EMS and it is up to Owen and Judith to recognise the improvements they want to make. When a specific goal is set, performance indicators are identified and the size and extent of the improvement is specified. For example, if they wanted to reduce the amount of waste coming from Garamea that is going to landfill, a specified percentage reduction is nominated with a target date attached. This gives them clear, measurable, specific goals to aim for.

Each year the Ruddenklaus review their EMS and make any appropriate changes that are necessary.

Monitoring

Naturally, record-keeping is an important part of the EMS and monitoring plays a key role in the program. Owen and Judith monitor a range of environmental indicators including water quality leaving the farm. After a significant rain event, if the water looks muddy, Owen knows that there is a risk of silting up the waterway that runs through his property and he needs to take some action to rectify the problem. All records are kept on paper.

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

ITEM	HOW OFTEN
Water leaving farm	Visual inspection after significant (> 50mm in 24 hr) rainfall event
Soil condition	Visual, on-going
Overgrazing	Visual, on-going
Pest species numbers	Number of pests killed, tallied every 6 months

Schedule of monitoring activities

Benefits and Costs

The greatest benefit the Ruddenklaus have obtained from the EMS is the improvement in their resource base. They are moving confidently into the future knowing that they are employing best management practices for the farm.

According to Owen, the EMS has also made it easier to meet legislated requirements, and risks and liabilities are minimised because problems with chemicals and land degradation have been identified.

Currently, prices paid for sheep and wool from a farm with an EMS are no different to one that does not have one. However, Owen and Judith hope that in the future, their customers will recognise the value of what they are doing on their farm by providing better prices for products that come from farms that are environmentally sustainable.

The Future

Both Owen and Judith are going into the future with a bigger environmental focus than they ever had before. They hope to plant more trees and reduce stock numbers, whilst still producing more per LMU.

The Ruddenklaus know that they will need to keep producing what the customer wants and environmental stewardship may well become part of the product specifications of the future.

The EMS has provided the farm with:

- a way of working with the environment
- a method to rationalise everything that happens on the farm
- proof that the farm is indeed sustainable.

Garamea is one of the farms in Otago that is able to provide its customers and the community with evidence of its environmental commitment.

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

Authors:
Gioia Small and
Genevieve Carruthers

Montana Wines

Integrated Winegrape Production

Tony Hoksbergen

Montana is New Zealand's largest producer and exporter of high quality wines. It has approximately 2400 ha of vineyards located throughout the North and South islands of New Zealand and is well recognised for its Sauvignon Blanc; a variety grown around the Marlborough region in the South Island. Sauvignon Blanc wines produced from grapes grown in this region exhibit exquisite flavours. These unique qualities have ensured the success of Montana wines in New Zealand and its export markets, including the United Kingdom and Australia.

Montana has recognised that if it is to continue to deliver a high quality product it must adopt a responsible and sustainable approach to its wine production. The company's environmental policy states that:

"The staff and management of the Vineyards Division of Montana Wines Ltd. are committed to the production of quality grape product by using viticultural techniques that provide for the sustainable management of our land and environment."



Map of New Zealand showing the locations of Montana's vineyards



To achieve this goal, Montana have made commitments to:

- minimise agrochemical usage;
- conserve and use groundwater responsibly;
- conserve energy;
- monitor agrochemical residue;
- support and conduct research to minimise environmental impact; and
- promote environmental integrity amongst its suppliers.

Montana believes that by complying with and exceeding regulatory requirements it can truly enhance New Zealand's wine promotional slogan:

"Riches of a clean, green land."

The Properties

Montana has vineyards and wineries in Gisborne and Hawke's Bay in the North Island and Marlborough in the South Island. The Gisborne region is renowned for wines that have intense, 'upfront' flavours. The Hawke's Bay region has an excellent reputation for Chardonnay and is showing good results with late maturing red varieties such as Merlot and Cabernet Sauvignon.

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

Montana pioneered grape growing in the Marlborough region when it planted the region's first commercial vineyard in 1975. Since that time, more than 60 wineries and over 4000 ha of grapes have been planted in the area. The Marlborough region has truly become one of New Zealand's famous wine trails.

One of Montana's largest vineyard sites in the Marlborough region is the Brancott Vineyard. This vineyard encompasses an area of 300 ha and is planted to Sauvignon Blanc, Chardonnay, Pinot Noir and Riesling.

The soils on the property are predominantly alluvial glacial outwash with some clay. Some of the oldest soils in Marlborough are found here; however, they are still relatively young in global terms being only 6,000 to 10,000 years old.

An ephemeral stream runs through the Brancott vineyard and the Fairhall River forms one of the boundaries, so Montana must ensure that its vineyard activities do not impact negatively on the health of these water systems.

People seeking an alternative lifestyle are also being attracted to the area seeking residential properties. This means that the district surrounding the Brancott vineyard is becoming increasingly sensitive to how agricultural pursuits are managed.

The Regional Council, a regulatory body that monitors the environment, performs regular checks including monitoring groundwater for nutrient loadings. It is essential that Montana manages its vineyard inputs, including pesticide, water and fertiliser use to minimise the impact it has on the environment.

The Staff

Montana has a dedicated team of professionals that have made a serious commitment to the environment. Tony Hoksbergen, the National Vineyards Manager, has been with Montana for over 18 years and is the driving force behind the introduction of the management program, Integrated Winegrape Production (IWP) that now operates in all of Montana's vineyards. Tony is a member of the working party that developed IWP and is a devotee of sustainable winegrape production.



Harvest time at Montana

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh



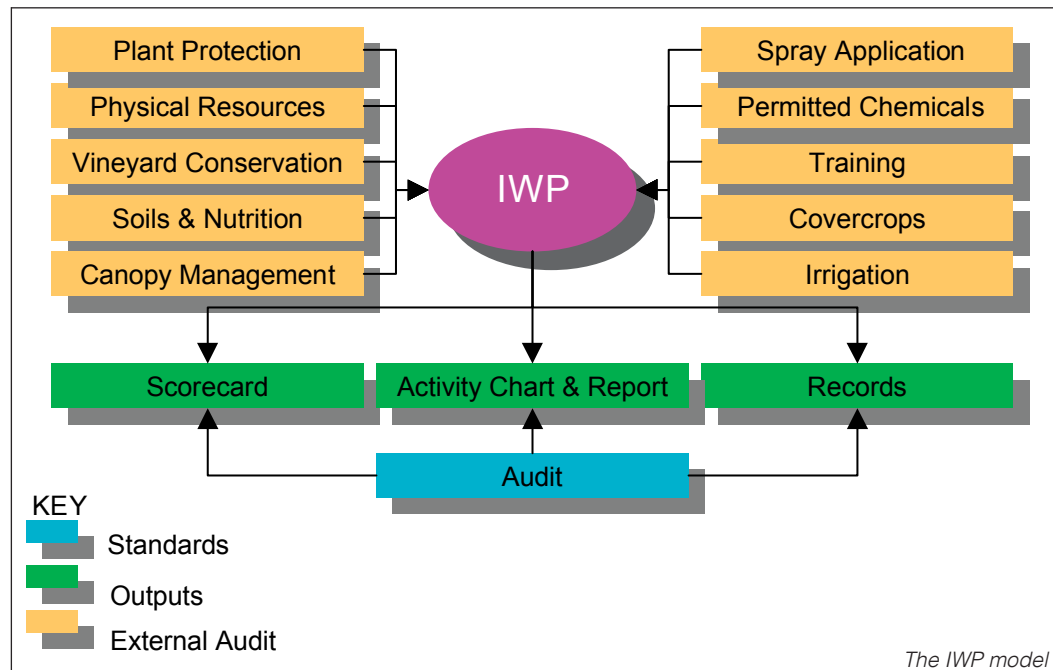
The Brancott vineyard near Blenheim

The Environmental Management Program (EMP)

IWP is a scheme developed in New Zealand. It brings together environmentally and ecologically sustainable production methods into one single program. The scheme is a holistic program that provides winegrape growers with a set of consistent, sustainable production standards.

IWP was established in 1995 as an initiative by the New Zealand wine industry. A working group made up of industry representatives, scientists and viticultural consultants drew on the concepts in the Integrated Fruit Production scheme designed at Wadenswil in Switzerland. Modifications were made to the Wadenswil model to suit conditions in New Zealand

and IWP was trialed throughout the industry. In 2000 it was introduced commercially to the industry and in its first year of operation was adopted by more than 180 winegrape growers.



Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

The figure above highlights the major components of the IWP scheme. Standards have been developed for all production practices and Montana uses these to guide the winegrape production process.

When a vineyard manager makes a production decision, he or she must ensure that it meets the criteria set out in the IWP. For example, if a vineyard applies fertiliser to the grapevines, it is only done in response to a soil and/or petiole analysis. This ensures that excess fertiliser is not being applied and the possibility of nutrients being leached into a waterway is reduced. Similarly, if chemicals are going to be applied in the vineyard, they must be on the list of approved chemicals and the application equipment must be calibrated on a regular basis.

All chemicals must be stored and mixed on bunded areas designed for that purpose

Montana has moved right away from routine soil cultivation and through IWP has adopted a policy of using covercrops in the inter-rows. This ensures that routine cultivation does not destroy soil structure and covercrops provide botanical diversity. Additionally, when covercrops are slashed, only every second row is mowed so that the remaining rows provide a habitat for foraging insects.

Weed control practices have also changed. Targeted spot spraying is used instead of broadcast applications of herbicides and the use of residual herbicides has been phased out.

Vineyard staff spend a lot more time monitoring for pests and diseases rather than routinely spraying for them and 'soft' chemicals are always the preferred option. All staff responsible for chemical application are trained and have a GrowSafe certificate.

Each year the vineyard manager must score his vineyard using a scorecard developed specifically for IWP. It is a major document in the IWP scheme. The scorecard addresses all production issues and identifies best practice for those areas. Managers are able to determine whether the practices they employ are sustainable and how far progressed the vineyard is in achieving sustainable targets.

Monitoring

Naturally, a system such as IWP needs records to support it. The IWP-accredited vineyards keep a range of records including:

- background information on the vineyard
- vineyard site maps
- plot maps
- pest and disease monitoring information
- weather information
- spray applications
- nutrition
- fertiliser applications
- irrigation
- vine performance and phenology.

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

A summary report is also produced each year that provides concise information on how sustainable the vineyard is.

Benefits and Costs

Montana has realised substantial benefits because they have adopted an EMP. They estimate that they have made savings in the order of 30 to 40% on their agrochemical usage. Although their vineyard staff spend more time monitoring, they are spending less time on the tractor spraying.

They now also have Standard Operating Procedures for chemical spills so staff immediately know what to do should something go wrong.

There are social benefits to IWP as well. Vineyard staff have responded well to the program, are enthusiastic and enjoy the involvement. They feel as though they have ownership of the program.

Vineyards are audited at random and can expect to be audited once every three years. Each vineyard pays a fee of \$300 per year to be in IWP. This covers audit costs, workshops and regular updates to IWP manuals. All Montana's vineyards are IWP accredited and over 50% of the national vineyard area has attained IWP certification.

There are some increased risks, however. Skill is required to be able to identify a problem in the field, so Montana must ensure its vineyard staff are adequately trained in pest and disease recognition. If a problem is not identified or is misdiagnosed, there could be costly ramifications. Overall, however, the benefits far outweigh any costs or risks.

The Future

The future for Montana's vineyards is a cycle of continual improvement. Vineyard managers will always be looking for ways to minimise their impact on the environment and improve the natural resources in their vineyards.

The wine industry in New Zealand has taken a clear leadership role in the adoption of EMS. There is a greater consciousness in the consumer of 'clean and green' and Montana is well placed to provide its customers with the assurance that Montana products are produced in an environmentally friendly way.

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

Mike Muller and Associates

Proving New Zealand kiwifruit is 'clean and green'

Mike Muller

Authors:
Gioia Small and
Genevieve Carruthers

The kiwifruit industry is truly one of New Zealand's success stories. The industry exports fruit to Europe and Japan and is developing markets in East Asia and the United States.

ZESPRI International Limited is the company that markets all of New Zealand's kiwifruit to the world. The company has created a vibrant and successful advertising campaign providing this commodity with a clean healthy image. In the year 1999/2000, total export sales amounted to over \$NZ650 million and the average orchard gate return per hectare was \$NZ27,898, making it a very attractive industry to be in.

Mike Muller is one of the growers who is part of this highly successful industry. He has a small property near Tauranga, on the Bay of Plenty. Here he grows kiwifruit, as well as providing a range of management and consultancy services to other kiwifruit growers.

Mike has been farming all his life and moved into the kiwifruit industry 27 years ago when he purchased his property in Tauranga. At the same time he also set up a spray-contracting service and over the years, Mike has been a very active member of the kiwifruit industry. He has part ownership of a packhouse which processes 8% of the national crop and also provides advice to ZESPRI on Kiwigreen, a program that was developed by the industry in response to market demands for fruit that was safe, clean and produced in an environmentally sustainable way.

Mike believes that there is a core set of goals that every kiwifruit grower should aim for. They are:

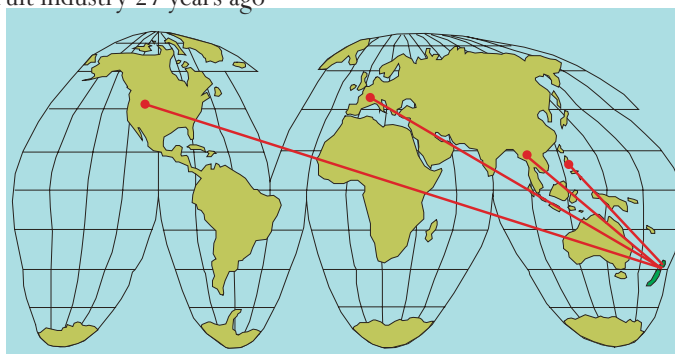
- *meet customer's expectations on fruit safety and quality;*
- *minimise chemical use; and*
- *improve and enhance the environment you live and work in.*

Mike's philosophy on kiwifruit growing is:

"Don't put anything on the fruit that will risk its safety; don't allow any chemical drift onto your neighbour's property; and keep all fertilisers on-farm."



Map of New Zealand showing the location of Tauranga



Map of the world showing the major markets for New Zealand kiwifruit

Case studies – New Zealand

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- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh



The kiwifruit orchard

The Orchard

Mike Muller has a small 1-ha orchard on the outskirts of Tauranga. The soils in the area are deep black soils overlaying volcanic ash. The area receives around 1300 mm of rain each year, ensuring lush, luxuriant growth on the kiwifruit vines.

Since the Muller family assumed ownership of the orchard, there has been a number of changes to the production practices employed on the property.

Weed control now consists of targeted spot sprays, as opposed to the traditional practice of general orchard spraying, and no residual herbicides are used at all. Because the soil was

volcanic, it was low in organic matter, so a program to build up organic matter was implemented. This consisted of planting covercrops in the inter-row areas.

Some of the properties that Mike and his orchard managers look after have streams on them and residential areas are fast encroaching on many of these orchards. Great care must be taken with all production practices to ensure that no environmental degradation occurs.

The Staff

Mike has a wealth of experience behind him in kiwifruit growing that he has accumulated over the years. His wife Trish looks after the office making the operation a truly family affair. The company looks after 30 other orchards totalling 200 hectares. Orchard managers are employed to assist with this part of the business. The key characteristics that Mike Muller looks for in his management staff are:

- good communications skills
- excellent problem solving ability
- sound technical skills.

To underpin these skills, the orchard managers are provided with six months on-the-job training with Mike before they are designated properties to look after.

The Environmental Management Program (EMP)

The EMP adopted by Mike and by the whole kiwi fruit industry in New Zealand is known as Kiwigreen. The program was developed some years ago in response to signals from the Italian market. This market made it quite clear that it was not

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- Mike Muller and Associates
- SoFresh

prepared to accept fruit with any chemical residues whatsoever. In fact, the Italian market rejected New Zealand kiwifruit, prompting the industry to search for some immediate answers.

To address this situation, the industry set about the task of trying to find a way of delivering residue-free fruit whilst still being economically viable.

A pilot program was established which was heavily reliant on pest monitoring rather than calendar-based spraying and in the first year of the trial, the industry was able to export 200,000 trays of residue-free fruit. Within three years, all kiwifruit growers had adopted Kiwigreen and today the industry exports 4 million trays of residue-free fruit annually.

The Kiwigreen program has a number of core components and these are highlighted in the figure at right.

On the farm, growers need to consider all their production practices to ensure that the quality and safety of the fruit are not compromised. Additionally, all practices must be environmentally friendly, providing assurance to export markets that New Zealand kiwifruit is truly 'clean and green.'

The story starts at the very beginning with orchard selection. Only sites that have the appropriate climate and natural resources are selected for kiwifruit growing.

During production, vine-training techniques are used to provide canopies with good air and light penetration, reducing the likelihood of disease.

Fertilisers are only used if a soil test indicates there are deficiencies. Because orchards are located in high rainfall areas, there is very little need for supplementary irrigation. Consequently, water (a precious resource) is not being wasted.

Weeds are usually managed with a spot-spraying program. Gone are the days when the whole orchard floor was sprayed out. This reduces the risk of erosion and inter-row swards provide a way of returning organic matter back to the soil.

Integrated pest management techniques are utilised, so a lot more time is spent monitoring, rather than spraying with insecticides. Any on-farm wastes such as vine prunings are mulched and returned back to the soil.

Once the fruit has reached maturity and is harvested, the Kiwifruit program continues to have strict control over the product.



The core components of the Kiwigreen program - Source: ZESPRI International 2001

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Regular testing is carried out on fruit samples to ensure that there are no residues in the fruit. The only post harvest treatment applied is ethylene to ripen shipments early in the season.

All packhouses have quality systems that are audited on a regular basis and any waste produced by rejected fruit is recycled back for fruit beverages or stock feed.

During storage, fruit is stored in coolstores which use refrigerants that meet international carbon dioxide level conventions.

In New Zealand, the Kiwigreen program is considered to be one of the most progressive and successful programs for managing product quality, product safety and the environment, and ZESPRI proudly uses it as part of its advertising strategy.

Monitoring

Environmental monitoring is a very important part of all production activities so that orchard owners and managers understand their impact on the environment. The table indicates some of the monitoring activities carried out in the orchards Mike is responsible for managing.

ITEM	HOW OFTEN
Soil	Every 2 years
Spray drift	Each spray application
Groundwater	Every 2 years
Silt buildup	Annually, dependent on level of risk

Schedule of monitoring activities

Review is another important part of the EMS and this is carried out on an annual basis. This allows Mike and his team to plan and improve their activities.

Benefits and Costs

One of the biggest benefits resulting from this program is that New Zealand has been able to maintain its export markets for kiwifruit. In a country with an economy so dependent on its exports, this is a big advantage indeed.

Product quality has improved because fruit is now residue free and kiwifruit growers have seen benefits to the environment in their orchards. There is less pesticide use and soil fertility is improving because of changed soil management practices.

Relations between orchard owners and the general community have also improved. Because the application of chemicals is carefully monitored, there is less risk of spray drift into sensitive areas.

Case studies – New Zealand

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- Garamea
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- Mike Muller and Associates
- SoFresh

The cost of making the changes is seen as a small price to pay to be economically and environmentally sustainable. Mike estimates that around 15% more time is spent on staff training and administration. However, the extra time spent on these activities has resulted in improved overall management due to the extra focus on planning and review.

The Future

The future for the New Zealand kiwifruit industry is particularly bright. It is an industry that is moving forward by exploring new markets. The fact that it is such a market-focussed industry will ensure that it will be able to keep up with market requirements.

Mike Muller believes that he will continue to change in response to customer needs. From practical experience, he knows that customers will not buy your product if it does not meet their expectations. Orchard owners will need to recognise consumer needs to stay in business. The kiwifruit industry has already experienced consumer demands for its product to be environmentally sustainable. Mike and other members of the kiwifruit industry know they have a program in place that can deliver the proof to its customers that the New Zealand kiwifruit industry is one of the 'cleanest and greenest' industries around.

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

Authors:
Gioia Small and
Genevieve Carruthers

The SoFresh Group

Satisfying the UK market's environmental requirements

Ross Seagar



Map of New Zealand showing the locations of SoFresh's operations

The SoFresh Group is a multi million-dollar operation based in Pukekohe, just south of Auckland in the North Island of New Zealand. The company produces and markets onions, potatoes and persimmons to both domestic and international customers. SoFresh is the sole supplier of potatoes to Foodland, one of New Zealand's major supermarkets. It also supplies the ETA Company with potatoes for potato crisp manufacture. The major buyer for SoFresh onions is Tesco, one of the United Kingdom's largest supermarket chains. Tesco's standards are high, with product quality and safety being of paramount importance. They also want to be assured that the products they buy have been produced with due care for the environment.

To ensure that Tesco's strict standards are met, SoFresh has adopted Tesco's own in-house program known as Nature's Choice. This program puts practices and checks in place so that Tesco can be confident that the goods they buy meet their specifications.

The Properties

SoFresh is a growing, packing and export company and the figure at right highlights the major steps in the company's operations. Produce grown on farms around the North Island is sent to the pack houses where it is sorted, graded and packed into bulk bins. These bins are then shipped in containers to a packer in the United Kingdom where the produce is placed into packages suitable for supermarket shelves.

SoFresh has properties distributed throughout the North Island of New Zealand. They have:

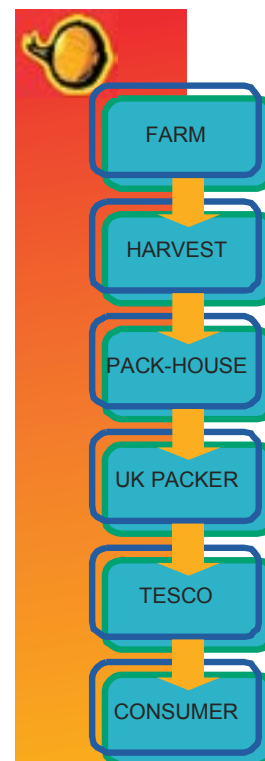
- a major production area and pack-house at Pukekohe;
- a potato and onion farm at Matamata;
- potato production at Ohakune;
- a pre-pack operation and potato farm at Levin; and
- a packing operation at Rakaia.

The Staff

The Wilcox family owns SoFresh. They are third generation farmers with a lot of experience and market knowledge behind them. Ross Seagar is one of the directors of SoFresh and is an accountant by profession.



Ross Seagar, a director of SoFresh examines product quality prior to export.



The major steps in the production and export of onions to the United Kingdom

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

The environmental aspects of fruit and vegetable production have become part of the consciousness of SoFresh over the last few years and Ross has had a substantial involvement in the development and implementation of the Nature's Choice program across all the company farms. The company is committed to providing Tesco with products that are truly 'clean and green.'

The Environmental Management Program (EMP)

As part of its EMP, SoFresh identified the main environmental issues for its farms. They are:

- agrochemical usage
- fertilisers
- prevention of pollution
- human health
- energy efficiency
- recycling
- wildlife and landscape.

SoFresh recognises these issues are as important as its business objectives and the company's Environmental Policy states that:

"The Group holds all staff accountable for the environmental protection measures that they control."

To help identify the environmental issues, SoFresh used a checklist provided by Tesco's Nature's Choice program and in some instances sought the assistance of a consultant to help with the environmental audit.

With the issues identified, the company was then able to develop and implement practices and procedures that would ensure its products were being produced in an environmentally sustainable manner.

Many things had to change. In the packhouse, all materials used for packaging and shipping had to be recyclable. On the farms, sediment controls were established to ensure that during periods of heavy rain, soil did not wash into waterways. Cultivation of paddocks for planting is now left to the last possible moment to minimise the possibility of erosion.

All chemicals are stored in lockable, bunded areas. Spraying is in response to a problem rather than reliance on a calendar-based program. More dependence is placed on monitoring to manage pest and disease problems.



The onion farm near Pukekohe



The grading line at Pukekohe

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh

On the farms, planting of trees has taken place to encourage biodiversity and areas of existing vegetation are being locked up.

Monitoring

Monitoring of the environment is an important part of the EMP and the company regularly performs checks on the status of soils and water quality on each of its farms.

The changes SoFresh has made enable the company to fully understand the impact it has on the environment and regular reviews are in place so that the information is used to improve and enhance environmental performance.

ITEM	HOW OFTEN
Soil condition and physico-chemical status	Soil tests taken prior to planting each year
Water quality	Chemical analysis done annually

Schedule of monitoring activities

SoFresh is also developing a pesticide-loading rating. This will enable them to measure pesticide inputs with measures other than simply the number of applications per season.



Newly planted trees on the farm near Pukekohe to encourage biodiversity

There is a pre-planting review conducted each season to decide on specific pesticides and fertilisers to be applied in the season. Records are taken on paper and then transferred to a computer.

Benefits and Costs

In Matamata, SoFresh has established a liaison between the local council and residents to address community concerns. Significant changes to the landscape were occurring because SoFresh was establishing a farm in the area. To guide the process, a code of practice was

developed in consultation with local government and the community. This community liaison has proven very successful with good outcomes for both the community and the company.

The commitment to environmental management SoFresh made meant that they needed to inject capital into existing and new infrastructure. As an example, there were costs associated with building bunded areas for chemical storage and mixing.

Around 50% more time is spent monitoring and there are associated administration costs and charges. Staff also need to be trained to ensure that they understand what the company is trying to achieve.

Case studies – New Zealand

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The greatest benefit for the company is the confidence that they are able to keep supplying one of the United Kingdom's largest supermarkets. The EMP they have adopted will ensure that strong demand for the company's produce continues both in the domestic and export market.

The Future

Without a doubt, the biggest issues in the future will continue to be pesticides and food safety. However, consumers want to be assured that the products they buy come from farms that are doing the right thing by the environment.

At SoFresh, the Nature's Choice program that has been implemented means that the company can provide evidence of being 'clean and green.'

Markets are becoming increasingly competitive, quality conscious and more environmentally aware. Having an EMP in place means that SoFresh is well placed to continue to maintain its presence and success in its lucrative European markets.



Locked up area of existing vegetation on the farm at Pukekohe

Case studies – New Zealand

- Shalloch
- Garamea
- Montana Wines
- Mike Muller and Associates
- SoFresh



Appendix 1: Environmental Management Systems Case Study Questionnaire

Interview with the:

- Owner/ Manager/ Environmental Officer/Director/Senior Manager
(circle appropriate)
of _____
(Name of Business/Enterprise/Farm).
- Date Conducted _____

1. Farm Location

Property/Business Name:
Nearest Town:
State:
Latitude/Longitude (if possible):
Bioregion (Tropical, Mediterranean etc. if known):
Height above sea level:

2. Property Description

Size of property: (note ha or acres):
Area used by the enterprises (also include how long each enterprise engaged in
and whether these enterprises are growing - G; declining - D; varied in response
to market/ weather - V or static - S:
Cropping: (break up into different crops if needed).
Grazing Sheep: Cattle: Goats: Horses:
Pastures Other grazing?
Intensive agriculture areas (poultry sheds/feedlots/piggery sheds/
greenhouses etc):
Native vegetation:
Agroforestry/Plantations:
Shelter belts/Corridors:
Roads/Dams:
House/Sheds:
Fallow areas:
Other:
Soil types present on farms – include parent material (map if possible):
Slope class(es):
Orientation of main farm areas:
Vegetation communities:
On-farm:
Surrounding farm:
Are there any drainage systems present (creeks, streams etc.)?

Appendices

- Appendix 1: Environmental Management Systems case studies questionnaire
- Appendix 2: Glossary
- Appendix 3: References

Are there any environmentally sensitive areas on the farm (eg. forests, wetlands, Aboriginal or other historical sites, remnant vegetation, significant threatened habitat, towns, villages)?

Are there any environmentally sensitive areas surrounding the farm (eg. national parks, state forests, wetlands, remnant vegetation, significant threatened habitat, towns, villages etc)?

Do you know of any endangered or threatened species either on the farm or around the farm?

How do you feel that your farm management affects the sub-catchment/catchment?

How do you feel that the management of the sub-catchment/catchment affects your farm?

3. Climate

Average maximum temps (include break-up into months if needed):

Average minimum temps (include break-up into months if needed):

Average rainfall (break into monthly if there are significant differences):

Period of maximum rainfall:

Average humidity:

Type of rainfall (even, storm, monsoonal etc):

Other features:

4. Farm History

Is the property a family farm?

If yes, when was it established and by whom?

If no, when was it purchased?

How has the condition of the farm changed since you took over?

How and why have those changes been made?

Enterprises:

Paddock boundaries/areas of usage alter:

Other changes?

Is it possible to get copies of some old farm maps/photographs etc. if they are available?

5. Farm Income

What is the proportion of income derived from the various enterprises?

Is there any off-farm income?

Has any of the environmental work on the farm been funded by outside sources?

Which enterprise (s) required the most amount of money/time spent on it to address environmental issues (regulatory, repair etc.)?

Has the amount of income generated from the particular enterprise(s) influenced management choices (i.e. – have you moved out of particular enterprises because of regulatory/licence costs, meeting required performance levels etc.)?

Appendices

- Appendix 1: Environmental Management Systems case studies questionnaire
- Appendix 2: Glossary
- Appendix 3: References

6. Prior Farm Management and/or Management Training

How long have you been farming?

If this is a career change, what did you do before?

Have you done any:

farm planning training, (If so, please list)

related management training? (list – eg. business planning, marketing, financial, computer etc.)

What level of education do you have (secondary/tertiary etc.)?

What level of training do other staff members involved in farm management have (if relevant)?

Are you or any family/staff members a member of (circle as appropriate and state who is a member of what):

Landcare?

Catchment management committee/board or group?

Industry group?

Market groups?

Focus groups?

Research group?

Other? (list)

7. Environmental Issues Covered in Farm Plan/EMS

What issues are being addressed in the EMS/farm plan? (list). For each one, assign a priority on a 1- low priority to 10 - critical priority.

Have any of these issues been addressed solely in response to regulatory pressure?

If so, which?

How were these issues recognised (eg. observation/monitoring, communication with neighbours, EPAs, Dept. of Ag., researchers, industry groups, personal desire/preference etc.).

Is there a written environmental policy? (If no formal policy, or not written, ask if the person can articulate it and record it here.)

8. Motivation for change

Was there any particular 'crisis' that stimulated change from previous/conventional management practices, or was the change a long time coming and a result of thought over time?

Were you pushed into making the changes by (circle, then expand on below)?

Resource conditions?

EPA or similar reg. agency?

Customer/buyer?

Other motivation/drivers?

When you started out, what were your overall management goals? Did they include a major focus on environmental issues?

Have those goals been achieved? If only partly, how well?

Have those goals now changed? If so, why and what are they now?

What were the drivers of change (eg, market, self-choice, regulatory agency)?

Appendices

- Appendix 1: Environmental Management Systems case studies questionnaire
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What are the markets for the products from the farm – domestic or international?
 If international, what areas (Asia, Europe, USA, UK, other)?
 Did any market pressures influence management changes?
 Are you getting market signals with regard to environmental issues in farming?
 Are these clear or ambiguous?

9. Confidence

How confident do you feel that planning and management changes are assisting in your overall management now? (Rank from 1-not very to 10-extremely).

Why? i.e. Has improved, longer-term planning helped increased certainty in decision-making?

How confident are you in the future of your farm? (Rank from 1-no confidence to 10-strong confidence.)

Why?

How confident are you in the future of your industry? (rank from 1-not very to 10-extremely.)

Why?

Has your confidence in the industry/your farm affected your investment in environmental management? How?

How confident are you that your investment/changes will assure your future farming in your current industry and /or at this site? (rank from 1-not very to 10-extremely).

10 Management Changes

What has changed in management? (circle, then expand on below)

- Soil management
- Water management
- Nutrient management
- Chemical application and storage
- Tillage practices
- Stocking rates/management
- Matching land use to land capability
- Recycling/alternative waste utilisation
- Efficiency of resource use
- Pollution prevention/control
- Mix/integration of enterprises
- Business approach (more planning, review etc)
- Vegetation management
- Biodiversity management
- More attention to planning (and longer-term planning)
- More attention to monitoring

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- More attention to recording (goals, monitoring results, outcomes etc.)
- Increased communication with neighbours
- Increased communication with regulators
- Increased communication with customers
- Other

11 Methods of Changes

How did you make the changes to management? (Circle, then expand on below)

- Did it yourself
- Did training, then did it yourself
- Used a consultant
- Made changes based on personal observation
- Member of a group – changes as a result of group discussion/research (state which group and method of determining change)
- Adopted ISO 14001
- Adopted organic standards
- Adopted Holistic Resource Management principles
- Adopted other resource management principles/approaches
- Other

Were any Best Management Practice(s), Codes of Practice etc. used? (If so please list them below). Rank their usefulness from 1-not very to 10-extremely for each BMP/ COP etc.

Did you previously have, or now have, any other management systems in place (such as QA programs, OH and S, HACCP, SQF 2000, own corporate systems)?

Do you think management systems such as QA, OH and S and environmental should be integrated? What do you see as the benefits and drawbacks of such an approach?

12 Sources of information

Where did you find information needed to make the changes?

How satisfied were you with information received from (1 – not to 10 – very)

Industry
 Dept. of Ag, DPI etc.
 EPA or Natural Resource Dept.
 Other farmers
 Greening Australia
 Landcare
 Industry group
 Consultant
 Neighbours
 Researchers
 Others?

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Whom do you think should be providing the information required to make good sustainable choices?
How should the information be provided?

13 Indicators of change

What environmental indicators are monitored on the farm, how are these measured and how often are they monitored? Include such things as physical monitoring - soil/water/leaf tissue testing as well as bird counts, vegetation condition assessments and management indicators such as financial reviews, communication with neighbours, EPA etc.

Issues	How measured	How often

How are the results of the monitoring incorporated into management decision-making? (eg. Is there an annual review, 6-monthly, weekly, pre-planting review etc?)

How are farm records (including management records, performance records etc) kept?

- Paper based/Farm diary
- Computer based (name program)
- Other

How well do you feel that your management changes have affected financial and environmental performance?

14 Communication with industry/other interested parties

Have outside parties (neighbours, regulatory agencies, other farmers, industry groups) been involved in planning changes? If so, why and how?

How are the changes to management and performance communicated to others (if at all)?

- Field days
- Articles
- Reports to industry/agency groups
- Conference papers
- Other

Which form of communication has worked the best?

If there has been community/neighbour and regulatory agency liaison, how effective has this been in resolving issues?

How do you keep up to date with any changes to legislation that pertains to the running of your farm (Include local to Commonwealth)?

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15 Benefits of changed management

What have been the major benefits arising from the adoption of improved management?

- Better profits
- Better yields
- Lower risks/liabilities
- Easier to meet legislated requirements/licence requirements
- Reduced fines
- Reduced licence fees
- Ease of gaining licences
- Improved resource base (soil/water health)
- Improved stock/crop health
- Increased biodiversity/return of species
- Gaining approved supplier status
- Improved market access
- Publicity
- Tax/rate relief
- Better community relations/neighbour relations
- Improved industry image
- Greater peace of mind/time with family etc
- Greater confidence in management
- Less time needed to fix problems (environmental or business)
- Improved human health and safety
- Others (list)

Can you provide an estimate of what the financial benefits might have been (perceived or actual)?

What have the social benefits been (perceived or actual)?

What have the environmental benefits been (perceived or actual)?

Have there been any other benefits?

Of the benefits that have occurred, did you expect them all, or have some come as a surprise?

Have you sought, or received – (list as applicable)

- Certification (if applicable) (to what)?
- Market differentiation of products?
- Branding/eco-labelling of products?
- Assured supplier status?
- Community acclaim (eg. Land for Wildlife membership etc)?
- Industry acclaim or support?

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- Awards?
- Other?

Has the change in management and/or associated keeping of records made it easier to assess the benefits (particularly the costs) associated with changed practices?

16 Costs of changes

What has been the cost of making changes to management? Some of these might be estimates and may be in terms of time taken to implement the changes.

Some of the costs might have been for

Training (self or staff).....	\$\$.....time (days, wks, mths etc)
Employing a consultant.....	\$\$.....time (days, wks, mths etc)
Infrastructure/capital equipment.....	\$\$time (days, wks, mths etc)
Employing new staff.....	\$\$..... time (days, wks, mths etc)
Monitoring costs.....	\$\$time (days, wks, mths etc)
Administration costs and changes.....	\$\$time (days, wks, mths etc)
Software.....	\$\$time (days, wks, mths etc)
Audit costs (if applicable)	\$\$time (days, wks, mths etc)

What has been the time taken to make the changes?

Have the changes in management made it easier to assess the costs associated with management?

What are some of the potential costs that would have occurred had the changes not been made? (If it is possible, estimate these – such as potential fines, time in dealing with EPA/neighbours/correcting problems etc.)

Have there been any disadvantages other than cost associated with changing your management to incorporate environmental goals? (List)

17 Marketing

Do you make use of improved environmental management in marketing? (If possible, obtain copies of any promotional material, or get photos of certificates held, labels, badging etc.)

Has this changed with time/management changes? (Describe)

18 Roles of Government agencies, industry and individuals

How 1) supportive and 2) involved were the groups below to the changes you made? (1 – not to 10 – very)

	Supportive	Involved
--	------------	----------

- | |
|----------------|
| Family members |
| Staff |
| Industry |
| Other farmers |

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Neighbours
 Agricultural Dept.
 EPA/sim
 National parks/sim
 State forests/sim
 Land and Water Conserv.
 Natural Resource Dept.
 Local Council staff
 Landcare members
 Resource management
 Agency staff
 Researchers
 Customers
 Others(list)

Would you recommend that others do what you have done? What would you recommend that they do differently?
 What support would you have liked to have received while you were making your management changes?
 Do you believe that there should be some financial incentives available to people who can demonstrate that they are managing their farms in a responsible manner?
 What sort of incentives?
 What other sorts of incentives could be made available that might encourage people to change (eg. tax rebates, rate relief, ease of gaining licences, relaxation of other regulations)?
 Who should provide these (Govt., industry etc)?

19 Future of enterprise and agriculture

How do you see your management evolving in the future?
 What environmental or management issues do you think you will address in the future?
 What do you see as the role of your industry group(s) in the future – how much leadership do you expect them/ want them to take in environmental issues?
 What do you see as the role for Government/regulatory agencies in the future?
 How do you think consumers/supermarkets could influence farmer management in the future? (Include in this the whole industry direction if applicable.)
 Do you believe that in the future consumers and others will require that farmers be more accountable for their farm management practices?
 Do you think your farm management systems will help you meet this need for accountability? Why or why not?

20 Other

Is there anything else you would like to tell me that you think might be of use in this study?

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Appendix 2: Glossary

ACF	Australian Conservation Foundation
AFFA	Agriculture Fisheries & Forestry - Australia
ANZECC	Australian and New Zealand Environment and Conservation Council
APFA	Australian Prawn Farmers Association
BFA	Biological Farmers of Australia
BMP	Best Management Practice
CAR	Comprehensive and Adequate Reserve (forestry term)
Cattlecure	Cattle QA scheme
CEO	Chief Executive Officer
CLIPCARE	Elders wool QA scheme
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DALCARE	Dalgety's wool QA program
DSE	Dry Sheep Equivalents – (for comparison there are approximately 10-14 DSE per milking dairy cow and 10 DSE per breeding beef cow)
EIP	Environmental Improvement Plan
EPA	Environment Protection Agency (or Authority)
EMP	Environmental Management Program
EMS	Environmental Management System
ESP	Environmentally Safe Production
EUREP-GAP	European Union Recommended Environmental Practice – Good Agricultural Practices
FLOCKCARE	sheep QA scheme
ha	hectares
HACCP	Hazard Analysis and Critical Control Point
HRM	Holistic Resource Management
ICM	either Integrated Crop Management (Europe) OR Integrated Catchment Management (Australia)
IGC	a private environmental consulting company
ISO	International Organisation for Standardisation
ISO 14000	the series of documents, dealing with EMS and tools associated with EMS
ISO 14001	the internationally recognised Standard for Environmental Management Systems
IMS	Integrated Management System
IPM	Integrated Pest Management
GIS	Geographic Information Systems
MSA	Meat Standards Australia
NAPCo	North Australian Pastoral Company
NHT	Natural Heritage Trust
OH&S	Occupational Health and Safety
PEMP	Piggery Environmental Management Plan
QA	Quality Assurance
QAS	Quality Assurance Services
QFVG	Queensland Fruit and Vegetable Growers
SILCS	Southcorp Integrated Loss Control System
SGS	Sustainable Grazing Systems OR a private company (Societe Generale de Surveillance) accredited to provide auditing and certification services
SOI	Southern Oscillation Index
SQF 2000	SQF 2000CM Quality Code (Safe Quality Food), a QA program
SQF 1000	SQF 1000CM Quality Code (Safe Quality Food), a QA program
TFS	Tangential Flow Separator

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- Appendix 1: Environmental Management Systems case studies questionnaire
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Publication 2: Adoption of Environmental Management Systems in Agriculture: An analysis of 40 case studies

Carruthers G (2005) 'Adoption of Environmental Management Systems in Agriculture: An analysis of 40 case studies'. Publication No. 05/032, (Rural Industries Research and Development Corporation: Canberra). Reproduced with permission from RIRDC, Barton, Canberra.

The second publication to arise from the RIRDC-funded EMS case studies was the analysis of answers provided by farmers to specific interview questions. For this publication, I reviewed the data collected during the interviews with farmers and which had been written up as individual stories about each farm, as presented in the previous publication. A more comprehensive literature review was also undertaken for this publication, to compare findings with those noted for EMS adoption in other industries and areas. I was the sole author for this work.

The purpose of this publication was to compare and contrast the approaches to environmental management (EMS or non-EMS) used by farmers who were generally recognised as being environmental practice leaders, and who might therefore be thought of as being similar in their approach to a range of issues. For the analysis presented here, responses from 17 EMS users and 23 non-EMS users were compared. Farmers not using an EMS were still taking a number of environmental issues into account in their routine management, and were described as using an 'environmental management program' (EMP) in order to distinguish them from farmers using the more formal ISO 14001-based approach. In addition, this work aimed to identify costs and benefits arising from either EMS or non-EMS approaches, to determine information sources used by the two groups and examine the range and types of environmental outcomes being achieved.

This publication is placed second because it represents a deeper analysis of the material gained in interviews for farmers than that presented in Publication 1. The results presented in Publication 2 reinforced for me that in some way, farmers who

were using an EMS were different to other farmers who were equally interested in environmental issues. The factors that could influence and support EMS adoption amongst farmers began to be evident in this work, and I was able to start to compare this information to that on EMS users in other industry sectors.

This publication serves to highlight some of the differences that were becoming apparent between farmers who chose to use an EMS and those who used less formalised approaches to management. While the numbers of farmers represented overall was low, the study included the vast majority of farmers in Australia who were using a formal EMS process at that time. This report was a major contribution to the understanding of factors that influenced EMS adoption, as it was first analysis of its sort for agricultural applications of EMS. In addition, the results indicated that many of the commonly held 'truisms' regarding EMS in agriculture at the time were incorrect. For example, there was the perception that only 'corporate' farmers or 'big' farms would be able to apply EMS principles; that all EMS users were more highly educated than non-EMS users; that only farms where numerous staff members were employed could implement an EMS and similar beliefs. The results of this study indicated that EMS users were diverse, and no relationship with education, financial status, or business structure was noted. However, EMS farmers did appear to be different in that they recognised and discriminated between more discrete areas of environmental management, they tended to use and develop relationships with a wider group of information providers, and that they had often participated in more off-farm learning experiences. The small size of the study did not allow statistical analysis to occur to a great extent, and indeed, the study had not been designed as a quantitative assessment of factors. For me, the importance of this publication was that after completing many of the interviews and talking with the farmers, it was apparent that there was 'something' different about EMS users, and I wanted to investigate what that something was.



Australian Government
**Rural Industries Research and
Development Corporation**

Adoption of Environmental Management Systems in Agriculture

An analysis of 40 case studies

A report for the Rural Industries Research and
Development Corporation

by Genevieve Carruthers
Environmental Systems Specialist
NSW Agriculture

Publication Number: 05/032



**NSW DEPARTMENT OF
PRIMARY INDUSTRIES**

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Foreword

This publication analyses the responses provided in interviews with over 40 farmers and farm managers in Australia and New Zealand from two farming groups – one having adopted a recognised EMS process usually using the specifications of ISO 14001 (the EMS group), and the other comprising farmers who use less formal environmental management programs (the EMP group).

The study provides an important benchmark to evaluate EMS implementation on farms in the future and identifies a number of areas of support required for farmers who wish to utilise EMS as a management tool. Some key findings identified that:

- over 90% from both groups said they had more confidence in their management, with 90% of the EMS group and 70% of the EMP group stating this would lead to increased investment for environmental management on their farms
- 25% from both groups reported that others had a higher regard for their farms
- 90 % of both groups reporting improvements in natural resources on their farms
- over 60% of both groups reported improvements in efficiency, yields, stock/crop health and profits
- 40% of farmers from the EMS group said there had been an improvement in neighbourhood and community relationships
- 30% of the EMS group reported that their staff were more involved in management
- 20% of the EMS group said that there had been an improvement in their living and working spaces
- biodiversity was addressed under all farm plans

Contrary to popular perceptions that implementing an EMS will require much more paperwork, it was the EMP group that reported increased monitoring and record-keeping activities. Similarly, utilisation of an EMS did not necessarily mean that greater costs of management occurred. Similar numbers of farmers in both groups reported expenditure in a range of categories, with the EMS group reporting less spending on infrastructure and equipment, but more on training and auditing.

This project was funded from RIRDC Core Funds provided by the Australian Government and is an addition to RIRDC's diverse range of over 1200 research publications. It forms part of our Environment and Farm Management Sub-program which aims to support innovation in agriculture and the use of frontier technology to meet market demands for accredited sustainable production. Most of our publications are available for viewing, downloading or purchasing online through our website:

Peter O'Brien

Managing Director

Rural Industries Research and Development Corporation

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Mick McGinnis (Rivendell)
Mike Logan and Rachel Holloway (Oakville Pastoral Company)
Mike Muller (Mike Muller and Associates)
Nick Gill and Peter Ashby (Southcorp Wines)
Owen and Judith Ruddenklau (Garamea)
Pam and Jim McGregor (Maybenup)
Pat and Anne Francis (Moffits Farm)
Paul and Tina Badcock (The Hermitage)
Paul Ziebarth (The Gums)
Peter and Janelle Witten (Witten Holdings)
Peter Jones (Andamooka)
Peter Paradice and Paul Troja (Rockdale Feedlot)
Ray Whear (Abbotsleigh Citrus)
Rob Wilson (Wandalup Farm)
Rohan Koenig (Rocky Point Prawn Farm)
Ron and Suzanne Watkins (Payneham Vale)
Ross Garsden and Dennis Williams (Main Camp)
Ross Seagar (SoFresh).
Russell Ford (Old Coree)
Ruth and Phillip Paterson (Moreton Hill)
Steven Mackay (Bolinda Estates)
Stuart and Leanne McAlpine (Cooinda)
Syd Clarke (Samara)
Tony Hoksbergen and Mike Insley (Montana Wines)
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Preface

The Rural Industries Research and Development Corporation funded this project, and contributed major sponsorship to the 1999 EMS in Agriculture Workshop, from which this project grew. The assistance and support of the Corporation, particularly that of the Resilient Agricultural Systems Program Manager, George Wilson, is acknowledged.

NSW Department of Primary Industries staff, Gioia Small, Suzanne Robinson, Chris Cole, Belinda Walker, and Genevieve Carruthers conducted the interviews. Therese Hulme of NSW DPI identified and collated most of the best management practice data. Wendy Dingle, Lyn Cullen, Narelle Tomlinson, Jim Hindmarsh (NSW DPI), and Brigita Arrowsmith (Southern Cross University) assisted in entering data and producing figures. Kay Hindmarsh provided valuable editorial and proof reading services in addition to giving a producer's perspective on the document. Cecile Ferguson of RIRDC developed the final format of this report. John Fisher (NSW DPI) and George Wilson (RIRDC) provided comments on earlier drafts. The input of all these people is gratefully acknowledged.

Finally, thanks to Phillip, Aaron and Georgia for putting up with this monster undertaking for so long. Thanks for keeping me (somewhat) sane.

“In God we trust. All others we audit”

Anonymous

Genevieve Carruthers

Environmental Systems Specialist

NSW Department of Primary Industries

May 2005

Abbreviations

AFFA	Agriculture Fisheries & Forestry – Australia (now known as DAFF – Department of Agriculture, Forestry and Fisheries)
BFA	Biological Farmers of Australia
BMP	Best Management Practice
CATTLECARE	Cattle QA scheme
COP	Code of Practice
CSIRO	Commonwealth Scientific and Industrial Research Organisation
EPA	Environment Protection Agency (or Authority)
EMP	Environmental Management Program
EMS	Environmental Management System
EUREP-GAP	Euro-Retailers Produce Working Group Good Agricultural Practices, a production protocol
FLOCKCARE	sheep QA scheme
Gipps Beef	a Victorian beef producers association working on EMS as a collaborative program
Graincare	grain QA scheme
ha	hectares
HACCP	Hazard Analysis and Critical Control Point
ISO	International Organisation for Standardisation
ISO 14000	the series of documents, dealing with EMS and tools associated with EMS
ISO 14001	the internationally recognised Standard for Environmental Management Systems
IPM	Integrated Pest Management
PMP	Property management plan
NAPCo	North Australian Pastoral Company
NSW DPI	New South Wales Department of Primary Industries (formerly NSW Agriculture)
OH&S	Occupational Health and Safety
QA	Quality Assurance
SAI Global Ltd	a certification body whose business divisions include business publishing, professional, and assurance services for a range of management systems
SGS	a certification body (Societe Generale de Surveillance) accredited to provide auditing and certification services
SME	small to medium enterprise
WVQMS	WVQMS ^{CM} Woolworths Vendor Quality Management Scheme

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Executive Summary

Background

The application of environmental management systems (EMS) on farms is in its infancy worldwide, despite its wider application to other industry sectors. In 1999, a national workshop was held at Ballina, NSW Australia, to discuss EMS implementation on Australian farms (Carruthers and Tinning 1999). Since then, the on-going development of EMS in Australian agriculture has gained international attention, with Australia recognised by many as a world leader.

However, for many people, both in Australia and overseas, the concept of applying a management process to natural resources on-farm is foreign; scepticism of improved environmental outcomes is common, and uncertainty regarding the benefits of EMS use remains one of the major barriers to support and adoption of this management tool.

Application of EMS processes, typically within the secondary industry sector, has led to a perception by some in agricultural industries that use of EMS on farms is 'beyond farmers', 'too hard', 'too complex' and 'too expensive'. Much of the uncertainty regarding benefits and costs of EMS implementation comes from a lack of information regarding its use in agriculture. Many of the methods of evaluation and measurement of EMS use and success may not be appropriate.


The interview results analysed in the current publication and the individual stories published previously (Carruthers 2003b) were developed to meet the expressed desire of the 1999 workshop delegates for information about the application of EMS to farming enterprises. What motivates a farmer to undertake an EMS? Does the use of EMS help farmers manage better? Are there any differences between using an EMS and addressing environmental issues in other ways? Are there market advantages to be gained? How do farm managers go about developing and implementing their EMSs and where do they get help? What does implementing an EMS cost? What are the environmental outcomes that arise? What benefits accrue to the business?

The aim of this report

To assess the usefulness of applying a process of management more usually associated with secondary industry within an agricultural context, there is an obvious need for baseline information.

Specifically, this report aims to:

- compare outcomes and experiences of farmers using EMS with non-systematic resource management approaches used by other farmers

- 
- examine the benefits EMS use may provide for farm businesses and the wider community
 - provide an early indication of some of the actual and potential costs of adopting and implementing an EMS on-farm
 - improve communication between farmers seeking to improve environmental outcomes associated with farming, and government agencies who provide assistance, support, and in some cases, regulatory roles
 - provide initial, baseline information to allow for a more fully developed set of metrics and indicators against which to frame informed questions and measurement of environmental, social and financial outcomes of EMS application
 - identify areas where further assistance and support from government agencies and private providers could enhance the adoption of improved natural resource management on-farm.

One central question framed in this study is ‘Does using an EMS add anything to existing farm management, where the farmer is already operating at a recognised “higher” level of environmental stewardship than their peers?’ Participants in this study were chosen because their environmental management skills were recognised by peers or agency staff. Farmers in both the EMS group and the environmental management program (EMP) group had already completed a range of environmental works on their farms. Both groups could be anticipated to be conducting farm operations with a high regard to environmental concerns, and therefore be reasonably expected to have similar attitudes to the environment. Is there anything different about those farmers who choose to use an EMS?

This study was undertaken at a time when EMS implementation on-farm in Australia was at a very early stage. Consequently, there was a very small pool of farms to study, and many of the EMSs implemented were in the first one to two years of operation. Therefore, these results, at best, allow for general analysis of possible trends, and suggested actions for future developments are tentative.

What is an EMS?

An EMS is an on-going cycle of planning, implementing, reviewing and improving the processes and actions that a business or organisation undertakes to meet both its own desired aspirations and, where applicable, externally regulated, environmental obligations. An EMS features a process of continuous improvement, and is based on management principles that are common across a range of areas, such as quality, finance, and occupational health and safety. The EMS management cycle can most easily be summarised as a ‘Plan, Do, Check, Act’ approach. These four features are expanded into a range of ‘elements’ in two internationally recognised documents, the ISO 14001 Standard (ISO 1997) and the Eco-Management and Audit Scheme Regulation (EMAS), which cover management areas such as risk assessment and analysis, planning, communication, training, document and record development and control, operational control, review and auditing. Farms in this study deemed EMS farm were able to demonstrate management practices addressed all elements

described in ISO 14001, but these farms had not necessarily been certified against that Standard.

What is an EMP?

Farmers who were following a range of practices (both natural resource management and/or business) are termed EMP farmers in this report. In some cases, these EMPs mirrored some, but not all of the elements being used in EMSs, however, all EMP farms lacked one or more of the elements that would be required for an EMS. For example, on EMP farms, environmental impacts may have been assessed, but not from a risk analysis perspective and the management practices did not show a consistent method of such impact identification and risk assessment. Most commonly, the EMP farms had not addressed the ‘systems’ elements covered on the EMS farms – written policy statements, consistent processes developed to cover training, communication, document and operational control and record keeping. This is not to say that the EMP farms and their managers were doing a better or worse job than that on EMS farms, just that things had been done differently. In many cases, the EMP farms could have met the requirements to be considered EMS farms with small adjustments to their management practices.

Study methods

This report provides an analysis of responses given by individual farmers and farm managers to questions asked during interviews (Carruthers 2003b). Responses are compared to determine if there are any major differences between the farmers using a non-systematic approach for farm management (the EMP group) and those using an EMS.

Case study participants were identified through recommendations from farm organisations and associations, conservation groups and state agricultural and regulatory agencies. Over 70 potential candidates were identified, with 40 participants chosen for the final study. Of these, 17 were using a formal EMS approach based on ISO 14001 or related systems (the EMS group); the others (the EMP group) were addressing environmental matters using various methods that did not include all elements regarded as ‘systems’ elements in their management approach.

Farms included in the study covered a range of enterprises – viticulture, aquaculture, mixed (usually cropping/livestock combinations), intensive and extensive livestock, horticulture, and broadacre cropping.



Key findings

Farm and farmer characteristics

More of the EMS farms were described by their owner/managers as ‘corporate’ farms and fewer reported off-farm income than the EMP farms. Farmers in both groups were sometimes operating more than one farm and slightly more of the EMS group had experience working in careers other than agriculture.

The demographics of the farmers were generally similar in both groups. Somewhat more of the EMS group reported they had completed ‘business related’ training.

Most respondents were members of an industry organisation: the EMS group more frequently mentioned membership of natural resource management groups, such as Landcare, catchment management boards and environmentally focused community groups; whereas the EMP group more commonly reported membership of production/industry, focus, marketing, and research groups.

The EMS group reported having more international markets for farm produce and also more commonly reported clearer messages about market expectations for environmental stewardship. However, the actual on-farm practices which were changed were influenced by market demand for more of the EMP than the EMS farmers.

Goals and motivations

Around half of each group stated that they had been concerned with environmental management from the start of their farming careers. Approximately 60% of both groups reported that their original goals had changed over time. The most common motivation for change from original goals was self-choice, with market pressures second. Regulatory pressure was not a major influence for either group.

When asked if there had been a particular crisis that had caused them to change practices, approximately 40% of both groups said there had been no particular crisis and that changes had occurred gradually, as a result of self-choice. For others, public pressure/opinion and customer concerns were the drivers on some EMS farms and salinity was the ‘crisis’ trigger for some EMP farmers.

Self-choice also was the dominating motivation to change specific practices for around half of each group. Approximately one-third of the EMP group stated that customers/buyers and resource conditions had been factors. The EMS group more commonly reported resource conditions and regulatory agencies.

How were changes made?

Changes on-farm were funded by outside sources in 60% of the EMP and 50% of the EMS group, mostly by state governments, for on-ground works such as fencing, revegetation and similar works. In the majority of cases, no funding was provided for systems development, and very few instances of support for development of

monitoring, reporting, recording or auditing of environmental conditions were reported.

To identify issues to address, the EMP farmers relied more on personal observations and group work, while the EMS farmers reported working more with consultants, probably because relevant groups (on EMS) did not exist.

The EMS group more commonly reported using best management practices, codes of practice, and, where they existed, catchment or regional management guidelines, and these were more likely to be environmentally focused.

Both groups reported similar levels of changes in business approaches. The EMP group more frequently reported changes to tillage, vegetation and biodiversity management than the EMS group, and more commonly reported changed levels of information gathering, such as vegetation mapping, monitoring and recording/reporting. They also reported more paperwork and communication with customers. The EMS group more frequently listed 'brown' environmental issues such as waste and pollution management. These areas are usually more difficult to address and, typically in EMS development, are dealt with after the more tractable issues have been covered.

Issues addressed in management

A major difference observed between the two groups was the number of issues addressed in the environmental management on farms. The EMS group covered, on average, 32.5 issues per farm whereas the EMP group reported routinely addressing only five. In part, this difference was due to the tendency of the EMS group to split issues into more categories, but was also due to them addressing a broader range of issues, including more waste, pollution, and 'business' management. To some extent, the different methods used to identify issues may have resulted in the wider coverage of the EMS group, with EMS consultants commonly raising issues such as pollution prevention, regulatory compliance, communication and training. The risk assessment process and the identification of environmental impacts and their root causes, that are components of an EMS, appear to promote a more discriminatory approach when identifying environmental issues of concern. The EMS group also more commonly demonstrated a heightened awareness of legal obligations and compliance requirements which could lead to the greater number of issues being addressed.

The top ranking issues for the EMP group (with group average priority ranks shown on a 1 – low to 10 – high scale) were:

- correct storage and use of chemicals (2.9)
- biodiversity management (1.96)
- tree planting (1.74)
- management of nutrients and salts in soil (1.43)
- pest and disease management (1.39)
- chemical use efficiency (1.3)

- flora and fauna management (1.26)
- salinity (1.22)
- water use (1.13)
- general farm management (0.87)

and for the EMS group:

- correct storage and use of chemicals (5.77)
- chemical use efficiency (5.29)
- legal responsibilities (4.47)
- financial management; soil nutrients and salts; biodiversity (all 3.88)
- on-site contamination (3.82)
- environmental contamination; soil conservation; soil health (all 3.71)
- water quality (3.65)
- pest and disease management (3.41)
- resource management (2.94)
- weeds (2.82).

Thus, between the two groups there appears to be a difference in priorities, with a higher focus on legal issues and compliance evident amongst the EMS group, who rated almost all issues higher than the EMP group.

Sources of information and communication about changes

Both groups indicated that industry sources were major providers of information, with departments of agriculture, consultants and researchers also important. Other farmers and departments of natural resources or similar were raised more frequently by the EMP group, with EPAs, Greening Australia, Landcare, industry commodity groups and neighbours more frequently reported by the EMS group. The two groups answered this question from a different context, with the EMP group often seeking information on particular management practices, whereas the EMS group were often seeking specific information on EMS. This group commonly expressed frustration at not being able to find a reliable and independent source.

On legal issues, both groups most frequently nominated farmer/industry associations as sources, with articles, the media/press and the Internet also being used.

Group mean rankings of satisfaction showed the EMP group rated information from departments of agriculture most highly, then that from other farmers, industry associations, researchers and consultants. The EMS group was most satisfied with information received from consultants, then researchers, EPAs, departments of agriculture, and finally other farmers.

Both groups believed that state government agencies and industry groups should play a major role in providing information to assist farmers making changes on-farm. The preferred source of information for the EMP group was field days or farm visits, while the EMS group more frequently nominated workshops.

The EMS group more often involved outside parties in planning changes on-farm. They most frequently nominated EPAs and industry groups, with departments of agriculture, R and D corporation and government funded researchers also involved in some cases. The most commonly nominated parties by the EMP group were EPAs, consultants and departments of agriculture.

Support and involvement with changes

Both EMP and EMS farmers indicated that industry had been the chief provider of support when making changes on-farm and five other groups (family, other farmers, neighbours, agriculture departments, and researchers) were also cited by most.

In terms of satisfaction with support received, both EMP and EMS groups rated family support the most highly, with industry second and staff support third for the EMP group. Staff were second and EPA support third in the EMS group. These differences in ranking may have been due to the different sorts of support being sought, with the EMS group generally unable to source support specific to EMS development from industry, but more likely to receive it from EPAs.

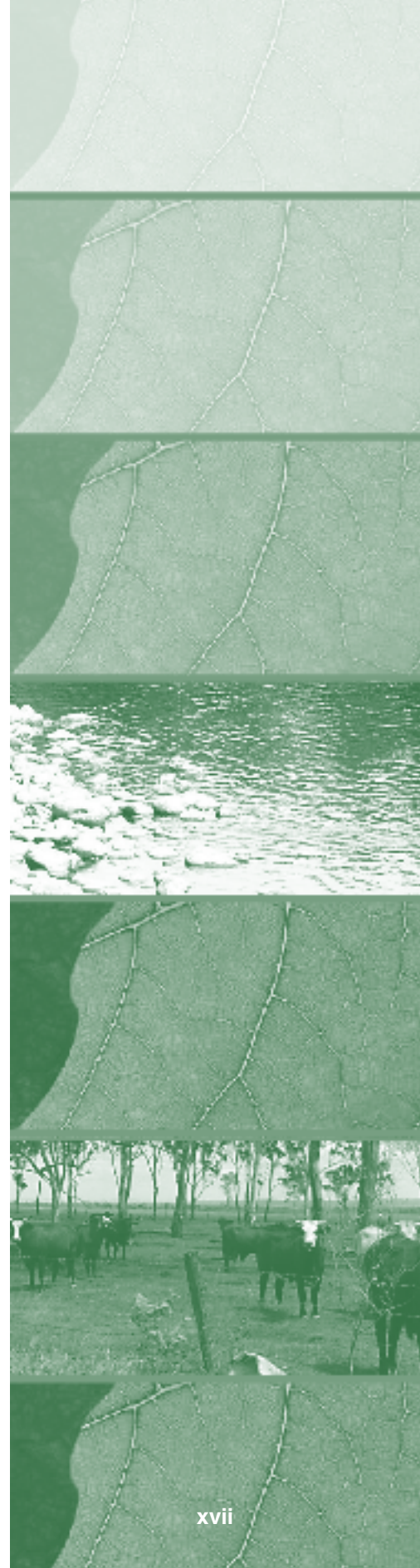
Similar parties were involved in making the actual changes as had provided support; however, fewer farmers reported involvement. Involvement of industry was reported by more of the EMS group, which was somewhat surprising given that frequently EMS farmers felt that others in their industry did not understand (or even know about) what they were trying to achieve with an EMS. Indeed, the EMS group reported being less satisfied than the EMP group with the involvement of their industry. However, the EMS group was more satisfied with staff, and certain regulatory agencies. This may have been because these latter groups were more able to provide information addressing compliance or planning matters, while the EMP group was often seeking information related to production and technical matters.


Indicators and monitoring of change, record-keeping, and reviews

A similar range of environmental indicators was used by both groups; however, the EMS farmers monitored a greater number of issues per farm (8.9) than the EMP group (5.4).

Few of the EMP farmers reported monitoring outputs but approximately 30% of the EMS group monitored nutrient run-off, and 25% monitored machinery use, fuel use, and solid wastes. To some extent, the EMS group may have been monitoring these issues as part of their overall attention to efficiency and compliance matters. Relatively low numbers of farmers in each group discussed examining indicators of business issues. Both groups also reported using financial performance as an indicator of change.

Farmers were asked how they used their monitoring results in decision-making. Less than 30% of the EMP group reported an annual review of performance, but over 70%





of the EMS group did. A periodic review is a requirement of the ISO 14001 Standard, and so high numbers of farmers in this group would be expected to report such activity. Six-monthly, quarterly, monthly, issues-based and pre-planting reviews were reported equally. The EMP group more often reported examining production-related issues, whereas the EMS group treated this question as dealing with a review of the management systems per se. Only the EMS group raised issues to do with monitoring the performance of the system.

Outcomes of changes made – benefits

In many cases, benefits were in areas that were difficult to assess in financial terms, and related more to individual personal feelings. The average number of benefits reported per farm was similar, in both groups.

More EMP farmers reported better environmental performance, despite using fewer indicators than the EMS group. Approximately twice the number of EMS farmers reported better financial performance. Very few farmers provided a response for business performance changes.

Farmers were also asked to outline the major benefits of changing their practices. In terms of environmental benefits, improved soil and water resources were raised by over 90% in both groups. Somewhat more EMP farmers than EMS farmers also nominated improved biodiversity. The EMS group more commonly raised the ‘brown’ environmental issues (reduction in pollution, wastes, and energy use), whereas the EMP group raised reduced erosion and nutrient run-off more frequently. Benefits reported are likely to link with original motivations and areas of practice changes.

‘More confidence in management’ was the most common social benefit reported by both groups, with ‘greater peace of mind’ and improved human health and safety other major benefits. Approximately 25% of both groups nominated a ‘better perception [by others] of the farm’ as a benefit. In the EMS group, around 40% of farmers cited better neighbour/community relations, with 30% nominating staff responses, 25% better perception of the farm, and approximately 20% ‘confidence in self/management’, ‘improved communication’ and ‘better living/work place’.

In financial terms, the most frequently cited benefit for both groups was ‘improved stock/crop health’ with better profits and better yields also frequently mentioned. More EMS farmers than EMP farmers suggested that input costs were reduced, with around 25% of the EMS group also stating that they had gained market share.

Market benefits reported by both groups were publicity and gaining approved supplier status, and the EMP group also noted improved market access. In general, market rewards for environmental management were not yet evident in terms of gaining price premiums. Where market benefits did occur, they related more often to food safety and quality assurance.

More of the EMS group than the EMP group had sought certification of their management approaches, with ISO 14001 certification reported most commonly,

then ISO 9000 and other QA programs. In the EMP group, Natures Choice/Field Fresh, a variety of the 'care'-type QA programs (such as CATTLECARE, Graincare or Flockcare), and the SQF 2000 approach were the most frequently reported approaches, but few farmers reported actually gaining certification or accreditation in these programs.

Most of the business benefits reported dealt with improved data flow and communication. Slightly more of the EMS group reported needing less time to fix problems when compared with the EMP group. Legal benefits reported centred on the reduction of risks and liabilities, and the ease of meeting licence requirements. Ease in gaining licences was mentioned by around 20% of farmers in both groups.

Both groups mentioned that they felt more confident in their management generally, and this confidence had affected their investments in environmental management.

Outcomes of changes made – costs

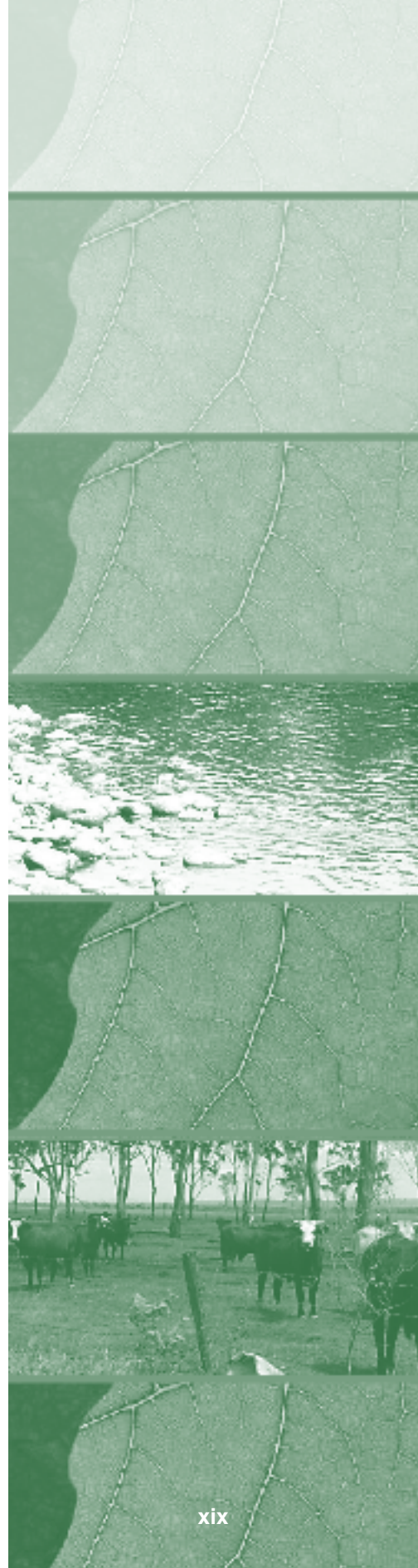
The EMP group most commonly reported expenditure on monitoring, infrastructure and equipment, training and auditing. The EMS group reported spending on consultants more commonly than the EMP group, but less frequently on monitoring, infrastructure and equipment. New staff, administration, and software were also categories of expenditure in both groups.


The similar proportion of farmers reporting expenditure on training and auditing in both groups is of interest, as both categories have been seen in the past as potential cost barriers to EMS adoption. In addition, more EMP farmers than EMS farmers reported expenditure on administration – generally described as record-keeping and office work – another area often touted to be drawback of involvement with EMS.

Costs of environmental management are not often assessed in isolation from other, production-related costs but, when supplied, the EMS group usually answered from a perspective of costs directly related to environmental management, whereas the EMP group more commonly included all costs in their answers.

EMP farmers reported spending \$1 000 per year or less on training, usually only for themselves or single other staff members. The EMS farmers provided training cost estimates of expenditure from \$500 to over \$10 000 in the year prior to interviews, often with several staff members undertaking training. Training specifically for environmental management had only been completed by the EMS group. The EMP farmers tended to only report course fees, which may also account for the lower costs reported. In terms of time, the EMP group reported spending between two and 18 days per year training, with the EMS group completing between four and 14 days training.

The EMS group reported using more consultancy services than the EMP group, often specifically to assist with EMS development, and in general spent more in this





area (\$5 000 – \$20 000). For the majority of the EMP group, consultancy costs were \$10 000 or less. The EMP group used consultants to provide technical advice or environmental advice, and were also able to source free advice in many cases. This option was not available for the EMS farmers for EMS advice in the majority of cases, and thus they were forced into paying for EMS consultancy services – a cost not incurred by EMP farmers.

The EMP group generally reported higher spending on infrastructure and equipment (\$5 000 to \$500 000) compared with the EMS group (under \$100 to \$10 000). Very little infrastructure spending could be attributed to specific environmental management in either group. This counters the oft-stated argument that implementation of an EMS must of necessity be an expensive exercise.

Low numbers in each group reported annual monitoring costs (\$500 – \$15 000) and administration costs (\$100 – \$5 000).

One area where there were clearly higher costs for the EMS group was auditing. The majority of the EMS group who provided cost estimates had spent \$2000 – \$3000 in the past year for auditing, whereas the EMP group had spent from under \$250 to \$2000. However, the EMS group were undertaking a wider range of audits, usually a combination of QA and EMS approaches, and so the additional expenditure is not unexpected.

The EMS group usually reported making changes in a shorter time frame (one to five years) than the EMP group (two to more than 10 years); however, the EMS farmers answered this question specifically in terms of the EMS development. Time taken to develop an EMS by the farmers in this study is similar to that reported from secondary industry businesses.

In terms of social costs, the EMS group more commonly mentioned the negative responses they had received from their peers, industry group and others, with peer disapproval often acting as a deterrent for seeking publicity or otherwise promoting what had been achieved. Generally, concerns had been expressed that, by highlighting environmental stewardship on their own farms, environmentally aware and responsible farmers were somehow disparaging farmers who were not involved in similar programs.

Finally, approximately 40% of the EMP and 50% of the EMS group said there were no disadvantages in changing practices, apart from more time spent in the office (mentioned by around 25% of both groups). Generally, most felt that only positive effects had arisen.

Integration of management

Farmers in both groups reported using a diverse range of management tools with certification or accreditation programs. In general, the EMS group tended to use

more recognised and externally audited systems-based approaches. Farmers in this group commented that the common elements present in ISO 9000, 14001 and OH & S standards facilitated the development of integrated management approaches, and provided the opportunity for integrated auditing procedures to be employed.

What sort of assistance and incentives were needed?

When asked about the assistance needed when they began making changes to their management, most EMP farmers nominated some form of financial assistance. The EMS group also favoured financial assistance as well as peer or industry recognition of their efforts. Provision of information, technical solutions and/or specifications, and support from a variety of agencies were also suggested, mainly through reduced licence fees and price premiums in the EMS group, and tax relief and subsidies for environmental works in the EMP group.

A similar range of incentives was also described to encourage other farmers to change their practices. Governments were seen as the most likely providers of incentives to change, but industry bodies and markets were also seen to have a role.

The future

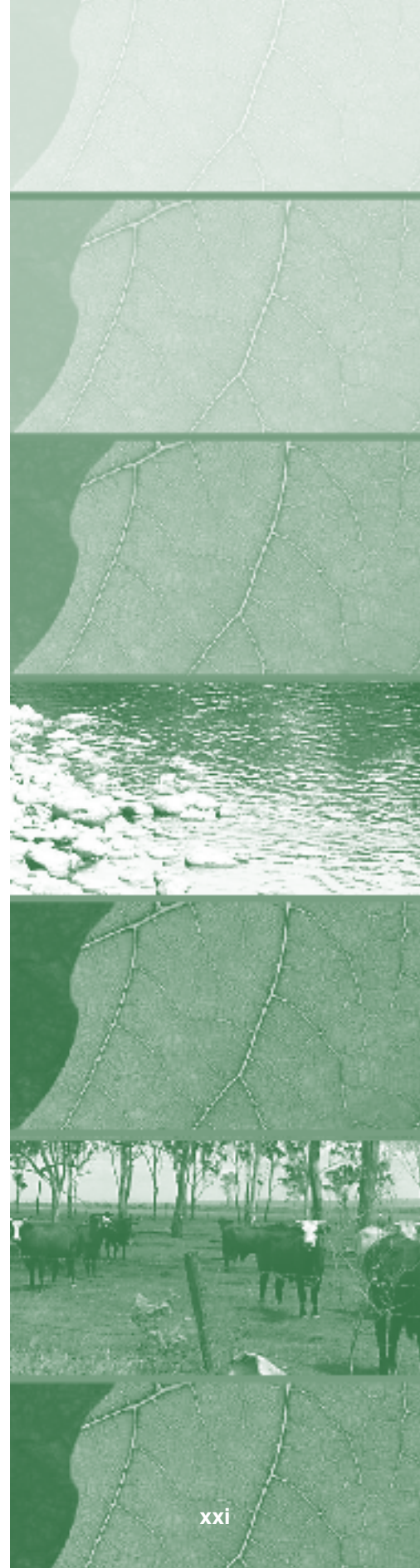
Farmers were asked to consider how their farm management might change in the future. The EMP group most frequently nominated gaining recognition or marketing the changes that had been made and the EMS group nominated changes in enterprise or business expansion, and 'continuous improvement'.

Soil health, nutrients, and erosion were the most commonly raised issues to be addressed by the EMP group in the future. The EMS group also commonly nominated soil issues, then riparian revegetation/management, and water issues. Again, more of the EMS farmers raised 'brown' environmental issues, and exclusively raised business areas for future inclusion.

Future expected roles for industry groups were investigated. A similar message came from both groups – 'Industry should be more proactive on environmental issues, show leadership in environmental management, and encourage green behaviour'. The EMP group suggested environmental management training and demonstration of how to translate regulations into practice. Marketing, lobbying, and building partnerships between regulatory bodies and farmers were also suggested.

For government, future roles suggested were a blend of providing support (financial, education/extension) and direction through regulations and standards. The EMS group also suggested that linking licensing to EMS implementation and levying fines against poor environmental managers were government roles.

Consumers and markets were also thought to have roles in the future, with preferential purchasing of 'environmentally friendly' products most commonly cited by both groups. Approximately 25% of the EMS group also thought that an awareness





campaign to educate consumers about EMS was needed. Branding or labelling was recognised as a requirement to allow for consumer support.

Finally, farmers were asked if they felt consumers would require them to be more accountable for their natural resource management in the future. Consumers were 'more aware' and would require 'proof' of good management, according to some farmers. Most of the EMS group felt they could provide proof, either through environmental outcomes, records or auditing, to meet increased accountability demands. Around 30% of both groups felt that the improved records they now kept would help them to meet the requirements for accountability. The issues of food safety and animal welfare were other areas farmers felt would need to be managed accountably in the future.

1. Introduction

1.1 What is an EMS?

An environmental management system (EMS) is an on-going cycle of planning, implementing, reviewing and improving the actions that a business undertakes to meet both its own desired and externally regulated environmental obligations and aspirations. An EMS features a process of continuous improvement, and is based on management principles that are common across a range of management areas, such as quality, occupational health and safety, and finance.

An EMS is a process designed to:

- assist with the recognition of environmental impacts, compliance issues, risks and liabilities
- develop an environmental policy that clearly states the aspirations, methods and timeframes to address these impacts
- gather and refine the information and data needed to meet the policy aspirations
- review and evaluate management choices in the light of whether the outcomes achieved met those specified within the environmental policy.

A business, or other organisation, implements an EMS in order to improve the way it manages the environmental impacts under its control. In many regards, an EMS is a vehicle for moving information around, so that better decisions can be made (Sheldon and Yoxon 1999). The EMS management cycle and constituent elements are depicted in Figure 1.

An EMS contains elements of risk assessment and total quality management (Lamprecht 1997), and relies heavily on the generation of data to inform management choices (Sheldon and Yoxon 1999) and communication (Sobnosky 2001). It is an iterative process that embodies the concept of continuous improvement where the system is constantly being refined, utilising information generated by the system itself. The EMS process as described is infinitely flexible and provides an ideal vehicle for managers of any business or entity to focus and improve their overall environmental performance.

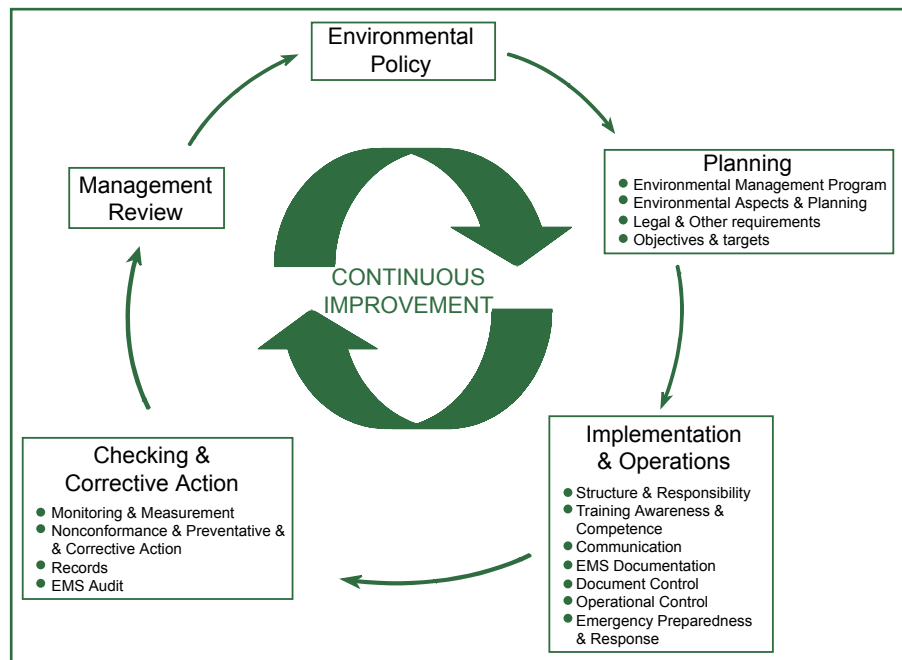


Figure 1. The Plan, Do, Check, Act cycle of management

The Commission for Environmental Cooperation (CEC 2000) released a Guidance Document that described 10 features dealt with in effective EMSs. These features were:

- a documented environmental policy
- environmental requirements and voluntary undertakings
- specified objectives and targets (these should include pollution-prevention strategies and information-sharing with stakeholders)
- allocation of structure, responsibility and resources
- operational control
- corrective and preventive actions and emergency procedures
- training, awareness and competence
- organisational decision-making and planning
- document control
- continuous evaluation and improvement.

The EMS process has been codified in two cases into internationally recognised documents, the ISO 14000 series and the Eco-Management and Audit Scheme (EMAS), a European Union regulation. The ISO 14001 Standard provides the specifications for developing an EMS, against which certification can occur. Only ISO 14001 can be used in Australia for certification purposes, as EMAS is limited to EU countries on a site-specific basis. The 10 principles described in the CEC document (CEC 2000) are reflected in the specifications for EMS detailed within ISO 14001.

The ISO 14001 Standard was developed following a proliferation of EMS approaches around the world, in an attempt to stem confusion and conflicts between competing approaches. The ISO working party structure and standards are recognised in over 170 countries and a lengthy consensus process is used to develop and ratify the international standards (Tibor and Feldman 1996).

The Australia and New Zealand Standard for EMS (AS/NZS ISO 14001: 1996) is identical to ISO 14001 and defines an EMS as:

...The part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy (Standards Australia 1996a).

Recognition and use of international standards offer protection for countries exporting goods, as under the 1994 GATT Agreement to Technical Barriers to Trade (TBT), use of standards not aligned to the ISO standards can be challenged by governments in other countries as technical barriers to trade (Panayotou 2001). For a country like Australia, where such a large proportion of agricultural produce is exported, use of internationally recognised standards minimises the risk of being locked out of markets on 'green grounds'. Panayotou (2001) pointed out that many countries which market products internationally find it easier to gain recognition for their environmental management efforts when they use internationally recognised standards for certification, rather than domestic standards. This is particularly the case where the domestic environmental

performance standards are perceived to be 'weak' compared with international competitors' standards. Use of an internationally recognised process such as ISO 14001 may well be crucial in order to gain credibility for 'clean, green' claims for goods such as Australian agricultural products entering an international marketplace.

Certifications against the ISO 14001 Standard worldwide numbered over 22 000 in 2000 (ISO 2000) with 205 of the certifications recorded by August of that year for agricultural or fishing businesses, a rapid increase from the 16 agricultural certifications reported in 1998. In Australia in 2000, 341 new certificates were issued (for a total of 1 049), ranking it sixth in the world behind Japan, UK, Sweden, USA and the Netherlands. Australia also had the first reported agricultural certification in the world; a cotton farm located near Narrabri, NSW was certified in March 1997 (M Logan pers. comm. 1997).

By 2002, there were over 30 300 organisations throughout the world with a certified EMS (Morrow and Rondinelli 2002; Babakri et al. 2003). Such implementation rates are more rapid than those noted for the adoption of the international Standards for quality assurance (the ISO 9000 series), the only other internationally recognised management standards comparable to ISO 14001. Corbett and Russo (2001) observed that while ISO 9000 series generated 28 000 registrations in the first six years of its use, the ISO 14000 series had 23 000 registration within the first four years. Corbett and Russo (2001) therefore suggested that ISO 14000 adoption globally will proceed at a greater pace than the ISO 9000 series. This may be because ISO 9000 'paved the way' and introduced businesses globally to a process approach to management that has been included (and some say, enhanced) in the ISO 14000 series. It is also important to note that not all businesses achieving certification to ISO 14001 make this information available to ISO, and so these numbers are likely to be underestimates. In addition, businesses using the ISO 14001 process may also choose not to undertake third-party auditing and certification, while still operating a successful EMS.

Prescription or process?

An EMS provides a management process to achieve the environmental policy and aspirations of a business in a flexible manner. It may highlight knowledge, training, data, research and resource needs. Compliant minimum operating parameters are met through the requirements to address all applicable legislation, but moving beyond compliance is encouraged by the 'continual improvement' concept. If there is a need to meet certain operating requirements (due either to regulatory or customer demand) then the EMS process can be used to achieve these outcomes, but the manner of achieving these outcomes is not prescribed. By using a process-based approach, an EMS encourages innovation, as it does not focus on pre-determined specific environmental outcomes or ways to achieve them, which is the case with some production-oriented best management practices and codes of practice. Further, Mech and Young (2001) highlighted the fact that because EMS (based on ISO 14001) is designed as a process standard, it can be used to integrate relevant product and performance standards, where they exist.

Prescription of outcomes can create problems when encouraging people to change behaviour. It removes flexibility, discourages innovation in finding solutions and diminishes opportunities for experiential learning, reducing potential efficiency, and overall ownership (and thus motivation to succeed). Moomaw (2001) discussed the dangers of prescription of either issues covered or how they are to be addressed. Defining specific practices and outcomes is costly (in both resources and time), whereas outlining an acceptable framework for planning, management, action and monitoring provides direction without prescription of behaviour or outcomes.

The EMS process means that, not only are environmental issues recognised, but active planning and management of them must also occur. Adequate resources must be provided to allow the issues to be addressed and timeframes set to meet goals. Further, there must be review of progress to ensure that the goals are being met, and changes in operating circumstances (such as legislation, climate, enterprises, and finances) are continually considered and acted upon. Indeed, enhanced planning has been linked to the adoption of sustainable practices in agriculture (Pomfret 2000).

Benefits of an EMS

Those implementing an EMS in non-agricultural industries have recognised numerous benefits associated with improved environmental management, with many small and medium-sized enterprises (SMEs) reporting 'real and valuable' benefits arising from EMS implementation (Hilary 1999, Tinsley 2002). National case studies in the United States of America, commissioned by the US EPA and the Multi-State Working Group on EMS, have examined the costs and benefits of EMS implementation in secondary industry applications (Darnall et al. 2000, Andrews et al. 2001, Edwards et al. 2002). The benefits occur, not only for the business implementing the EMS, but also for customers, the wider community, and the environment. The culture change in management style (from reactive to proactive) is often cited as one of the best features of EMS adoption, and joins other intangible and difficult-to-value features such as confidence in management and improved community relationships.

The increased focus on business management, production efficiencies, and the reduced risks and liabilities have meant that entities implementing an EMS frequently report better financial performance, as well as improved environmental outcomes. Florida and Davison (2001) summed up this new approach to increased business efficiency and enhanced environmental management as a 'lean and green' approach. In a study conducted by Speir (2001) some firms provided detailed information on financial benefits. In one business, former waste disposal costs of US\$100 000 per annum were turned into a US\$100 000 product. Another reported insurance premium savings of US\$4000, in addition to savings in production of \$35 000 per year. In a study in Sweden (Speir citing Enroth and Zackrisson 2000), 30% of the surveyed companies which had adopted an EMS were able to demonstrate increased revenues resulting from EMS adoption, and believed that there was a connection between the EMS and improved performance.

Speir (2001 citing a study conducted in the US by Pillsbury, Madison and Sutro 2000), reported on benefits accruing due to the industrial application of EMS. Compliance costs fell by 30%; regulatory innovation (such as streamlined reporting, monitoring data collection or gaining of permits) increased in more than 60% of cases; compliance issues decreased by 77%, and product quality improved.

By placing increased emphasis within a business on awareness of the resource conditions, environmental impacts, and environmental obligations, the EMS process forces a more critical examination of the effects on the business. It highlights support structures that may be needed to help meet these obligations and aspirations. However, by using an EMS process such as that outlined in ISO 14001, there is considerable flexibility in how obligations and aspirations are to be met – there are no prescribed courses of action to follow, as is often the case with best management practices (BMPs) or codes of practice (COPs). This flexibility is crucial for innovation in developing solutions – a feature essential to allow experiential learning, according to Moomaw (2001). Moomaw claimed that such experiential learning yields the greatest efficiencies and results, a major motivation for anyone adopting changed practices.

The EMS process provides an opportunity to support claims of environmental friendliness that might be made in environmental labelling and ‘green marketing schemes’. While Australia markets heavily on the ‘clean and green’ theme, there are increasing concerns that these claims may not be able to be validated. Similar concerns are echoed in Europe, where there is recognition that many industries may now be ‘clean but not sustainable’ (Steger 2000). By clearly outlining the environmental goals of a business in the environmental policy statement, and by being able to demonstrate that programs are in place to meet these goals, users of an EMS can more easily provide ‘proof’ of their environmental stewardship. In some cases, the adoption of an EMS has been used to support claims of ‘due diligence’ in environmental management.

Since the 1980’s, there has been a rise in the advocacy for increased ‘self-regulation’ in the areas of environmental protection and pollution prevention (Andrews et al. 2001). In some countries, the development and implementation of an EMS (or an EMP – environmental management plan) are requirements for operating conditions for certain industries. This is also the case in Australia, where at least two states (Victoria and Western Australia) have developed accredited licensing arrangements (Gunningham and Sinclair 1998). These schemes promote the adoption of improved environmental performance and management, although both stop short of requiring a certified ISO 14001-based EMS.

An important feature for the acceptance of self-regulation is the use of third-party verification to assure the community that desired outcomes are being achieved. However, this verification is not always required to confirm the specific practices used to achieve the outcomes. The outcomes are the desired result, with less emphasis on how the outcomes are achieved. In the case of ISO 14001, the Standard is operated on a voluntary basis and is often seen as an alternative to increasingly stringent regulation.

For example, the Wisconsin Green Tier program (Meyer 1999) aims to promote adoption of an EMS by easing certain regulatory and reporting requirements (CEEM 2001) in return for demonstrated achievement of superior environmental performance that goes “beyond compliance.” EMSs are amongst a suite of tools being adopted by larger businesses to help with self-regulation (Williams et al. 2000).

EMS in Agriculture

At the time this study commenced, no studies had focused purely on the agricultural use of EMS. The application of EMS on farms was still in its’ very early stages worldwide, despite much wider application in other industries, and any EMSs used on-farm were still in the first two to five years of operation. For many people, the concept of applying a management process to natural resource management on-farm was foreign; scepticism of improved environmental outcomes, common.

Newbold et al. (1997) claimed that the agricultural community in Europe had shown no commitment to EMSs (based on the now-redundant British Standard 7750, and the current EMAS Regulation) ‘possibly because most have not identified market benefits and see it as a time-consuming paper exercise’. In general, the concepts of EMS are unknown within the farming sector, even though many of the normal farm-planning practices fit well into the overall planning approach used in EMS process.

For agriculture, while the total savings and benefits might not reach the same monetary value as described above in secondary industry, it is likely that a range of benefits will accrue through the application of systematic management. Harrison (2002, citing Deming 1986) claimed that, for most industries, 85% of the operators’ effectiveness is determined by the production system, and only 15% by the operators’ own skill. Harrison went on to claim that the greatest leverage for change and improvement is through the production systems applied, and that significant improvements and cost savings will be achieved by improving the operations’ management processes.

Barriers to EMS adoption – document control or document controlled?

Barriers to EMS adoption and implementation described by Hilary (1999) when discussing small to medium enterprises are also relevant to farmers, who could easily be described as being involved in ‘nano-enterprises’. Barriers to EMS uptake outlined in Hilary (1997) and Ibbotson (1997, cited in Knowles and Hill 2001), included:

- lack of knowledge about EMSs and their potential benefits
- a lack of qualified personnel within the organisation to develop and implement the system
- a lack of resources
- a lack of knowledge regarding the environmental issues and environmental management
- difficulties establishing environmental aspects and impacts
- determination of priority/significance
- a lack of time to develop and implement the EMS

- a lack of finance for costs associated with ISO 14001 certification processes
- a lack of interest, in some cases, by management staff
- lack of continuity of the process
- attitudes that environmental management is not 'core business' or an area that offers economic benefits.

Tinsley (2002) examined advantages, disadvantages and organisational barriers that can occur at every phase of EMS development. Johansson (2002) added the cost of certification to the list of barriers. All of the barriers above seem likely to occur in agriculture. However, while farms may be regarded as 'nano-enterprises', they should realise benefits from EMS implementation similar to those identified amongst small business EMS users, although the specific benefits may differ from those observed in secondary industry application.

Lack of awareness about the use of EMS generally (amongst managers, regulators and consumers) is a major problem, one which Johansson (2002) claims is the biggest barrier of all to adoption of ISO 14001. Another is the perceived complexity of available solutions, a more general barrier to uptake of enhanced environmental management practices postulated by Cary et al. (2001). Williams et al. (2000) also claimed SMEs were unlikely to tackle environmental issues if they were perceived to be too difficult to solve and if they gave no immediate financial advantage when addressed. However, smaller enterprises can make a great difference in the environmental impacts experienced in any area, through cumulative effects of individual efforts (Johansson 2002), and so the opportunity to enhance such improvements within any industry sector should not be ignored. In particular, the use of EMS by individuals on farms as a means to achieve catchment-wide outcomes appears to offer great potential.

A lack of training in, and techniques to implement, EMS amongst those providing support to EMS implementers was also raised by Hilary (1997), and this exacerbates many of the above barriers. The lack of an EMS facilitators' network in Australia that has experience with agriculture is a major current barrier to provision of EMS support.

In Australia, farmers, farmer support agencies, regulatory agencies, and consumers are relatively uninformed about the use of EMS and the associated business, environmental and social benefits that can accrue as the result its application. This lack of knowledge can act as a significant barrier to adoption in the agricultural sector. Kirkland and Thompson (1999) highlighted a further barrier – that of research into the theory, but not practice, of EMS, resulting in a 'dearth of documentation and analysis of specific cases of EMS implementation'. They attributed this problem to both the 'newness' of EMS implementation in many cases, but also to competition between practitioners.

Tinsley (2002) stated that larger businesses are more likely than SMEs to have an EMS, mostly due to the additional resources available to develop such management approaches. Accordingly, in Australia, Williams et al. (2000) found that over 90% of the working population is employed by small to medium businesses, and that these enterprises have not adopted EMSs to the extent that larger firms have. These authors

also examined the limiting factors for EMS adoption amongst small secondary industry businesses in Western Australia. Chiefly, concerns centred on issues related to costs, time and documentation. Cary et al. (2002) found that farmers were more likely to adopt practices where:

- the perceived risk of doing so is low
- the results can be easily trialed
- benefits can be easily demonstrated
- changes are seen to be less complex than current practices.

For EMS application to agriculture, the above requirements are not currently easily met, as knowledge about the EMS approach and potential/actual benefits is low. Knowles and Hill (2001) stated that amongst South African farmers, there were often negative perceptions about management systems, rather than environmental management per se, with these negative perceptions ‘militating against their adoption’. Farmers they studies had a culture of intuitive management, rather than strategic planning and management and did not see the need for formal management approaches. Further, Williams et al. (2000) stated that, even if managers of SMEs did hold positive attitudes to environmental issues, there was limited awareness of business issues related to environmental management, and thus business management practices were not adopted as a way of improving environmental performance.

Much of the uncertainty regarding benefits and costs of EMS implementation on-farm comes from a lack of information regarding the use of EMS in agriculture – an issue this research aimed to address. The ISO 14001 Standard was developed largely by representatives from secondary industries and the regulators that oversee them, and information on the use of EMS has largely come from the secondary industry sector (Johansson 2002). This has led to a perception by some in agricultural industries that use of EMS on farms is “beyond farmers”, ‘too hard’, ‘too complex’ and ‘too expensive’. Interestingly, many of the same perceptions were also expressed about the application of EMS in the industrial sector in earlier times (Newbold et al. 1997, Corbett and Kirsch 2000, Andrews et al. 2001).

The associated performance measures and analysis of outcomes from EMS use have concentrated on issues and metrics that are pertinent to secondary industries and they often have limited relevance to agriculture. Many of these methods of evaluation and measurement may not be appropriate for agriculture, but this does not mean that farm businesses cannot benefit from the application of a management process.

In general, Australian farm operations are covered by fewer legislative and regulatory requirements than other forms of industry, and relatively few approvals must be gained before farming operations occur. Where legislation exists, its application to farming enterprises is often unspecific and farmers are not provided with clear indications of what an allowable practice might be (unlike the traditional ‘command and control’ scenario faced by secondary industries). Thus, there are few clear regulatory drivers for EMS adoption within agriculture at present. In addition, many farmers would

see accredited licensing schemes as too prescriptive and beyond their resources to implement. Other means of encouragement will need to be found if the application of EMS is to become commonplace within the agricultural sector. However, few of the incentives associated with accredited licensing arrangements apply to farms, and thus provide no incentive for farmers to develop an EMS. In addition, validating that such performance parameters are being met is costly, and in many cases in agriculture, the 'correct' actions and outcomes may not even be known.

EMSs represent a major opportunity to integrate many of the existing sources of management information available to farmers (Harrison 2002). Mech (2002) recommended that agricultural industries need to develop more complete guidance and best management practices for farmers to apply routinely in their resource management. However, an EMS allows farmers to follow a flexible series of steps that can assist in demonstrating stewardship of their farms, provide valuable internationally recognisable support in green marketing claims and supply outcome-focused data for use in both enhanced business and natural resource management planning. It also allows sufficient 'customisation' to occur in order to generate ownership. Harrison (2002) suggested that producers may view prescriptive programs detailing regulations and standards to be met as 'incompatible with viable production agriculture' and so, EMSs could further provide a means to enact many of the recommended practices while not being prescriptive in how solutions could be applied.

Two voluntary production-oriented arrangements for agriculture – the Australian Organic Standard of the Biological Farmers of Australia (BFA) and the EUREP-GAP protocol have recently recommended integration of a process approach into their prescriptive standards (Mech and Young 2001). In the case of the BFA's Organic Standard (BFA 2002), this process standard is an EMS (A. Monk pers. comm. 2003), whereas in the case of the EUREP-GAP protocol, the process standard may be either an environmental or quality management system. It is likely that in the future, increased numbers of 'hybrid' process/production oriented standards will be developed (the Canadian Environmental Management Systems for Hog Operations Standard CAN/CZA 771-04 is an example of this approach).

In Australia, a national workshop examining the use of EMS in agriculture (funded by NSW Agriculture, the Rural Industries Research and Development Corporation, Land and Water Australia, and others) was held in 1999 at Ballina, NSW. This was the first time that Australian agricultural stakeholders had gathered to discuss the implications of EMS implementation on Australian farms (Carruthers and Tinning 1999).

At the Ballina meeting, a range of questions regarding the value of using this process on-farm was raised. The questions included the motivations for EMS adoption, benefits, and costs arising from implementation of an EMS, and methods and information available to support farmers wishing to use an EMS approach. The analysis presented in the current publication (and the case studies presented in Carruthers 2003b) were developed to meet the expressed desire of the 1999 workshop delegates for information about the

application of EMS to farming enterprises. Does the use of EMS help farmers manage better? Are there any differences between using an EMS and addressing environmental issues in other ways? Are there market advantages to be gained? How do farm managers go about developing and implementing their EMSs and where do they get help? What does implementing an EMS cost? What are the environmental outcomes that arise? What benefits accrue to the business? One central question posed by this study was 'Does using an EMS add anything to existing farm management, where the farmer is already operating at a recognised "higher" level of environmental stewardship than their peers'? Without data on the benefits and costs, motivations and the overall 'context or conceptual frame' that managers use, questions regarding the use of EMS within agriculture cannot be developed or answered.

1.2 Objectives

The case studies detailed in the current publication were developed to meet the expressed desire of the 1999 EMS workshop delegates for information about the application of EMS to farming enterprises. The range of questions asked can be summarised simply into one – 'What use is an EMS?'

Subordinate questions included:

- Does the use of EMS help farmers manage better?
- Are there market advantages to be gained?
- How do farm managers go about developing and implementing their EMSs
- Where do they get help?
- What benefits accrue to the business?
- What does implementing an EMS cost?
- What are the environmental outcomes that arise?

Similar questions were asked of EMS implementation in secondary industries (Andrews et al. 2001).

The use of EMS in Australian agriculture since the 1999 workshop has gained international attention, with Australia recognised by many as a world leader in the application of the EMS process to farms. The development of a national Framework for EMS in Agriculture (Standing Committee to the Natural Resource Management Ministerial Council 2002) is an initial attempt in Australia to provide a context to EMS development, and to stimulate discussion on the use of EMS as a tool to achieve enhanced environmental outcomes in Australian agricultural enterprises, and has increased the recognition of EMS work done by Australian agricultural industries.

This report attempts to redress this lack of knowledge of EMS application in the farming context and provide some early data against which to benchmark future developments. The study was undertaken at a time when EMS implementation on-farm in Australia was at a very early stage. Consequently, there was a very small pool of farms to study, and many of the EMSs implemented were in the first one to two years of operation with many of the benefits, costs and implications were still to be fully determined. Both groups of farmers participating in the study had undertaken environmental works in

advance of the majority of their industry peers – the two groups had however utilised different approaches.

Findings are therefore general, and further investigation with a larger sample recommended in future. In addition, in the time since the interviews were conducted, there have been changes both on the individual farms and in the wider adoption of EMS on Australian farms. Some of the farmers who had a certified EMS when interviewed have subsequently surrendered their certification (while still maintaining their systems); other farmers who had not sought certification when interviewed have gone on to seek and gain certification to ISO 14001. Still others in the EMP farmer group have moved to using an EMS. These changes reflect the dynamic nature of agriculture of Australia, where the one certainty is that things will change with time.

2. Methodology

2.1 Choosing case study participants

Australian and New Zealand farmers recognised as leaders in environmental management on their farms were targeted as participants in this study. They were identified by recommendations from farmer and industry groups, state agricultural, resource conservation and regulatory agency staff, certification companies, and by publicity about some of the farmers who had won environmental awards. Other areas of interest in selecting potential candidates were farm businesses making use of environmental labelling or marketing, and those who were selling into known 'environmentally sensitive' markets.

Criteria for inclusion in the study included the ability of the participants to demonstrate commitment to improving environmental outcomes associated with their farming activities, recognition of the environmental outcomes being achieved on the farm, and willingness to take part in the project. Some participants in the study were using the ISO 14001 Standard to guide their management, but many had never heard of the Standard. All participants had gone beyond the development of a farm plan and were actively engaged in addressing environmental issues on their farms and in their businesses.

Over 70 potential candidates were identified by this peer recommendation process and were initially interviewed by telephone to assess:

- whether or not they were using some form of farm plan
- the issues addressed in that plan
- environmental issues facing the farm
- potential and actual impacts of farming operations on the environment
- how these impacts had been recognised
- whether there was a formal environmental policy statement (either written or verbal)
- what monitoring was being undertaken to assess progress towards the stated goals
- how such monitoring was being used in decision-making
- whether the interviewee or farm staff members were involved in any farming, industry or research groups.

From the initial pool of candidates, 40 were selected for a process of interviews and case study story development. Final participants were selected on a number of criteria, including:

- their ability to clearly articulate, or provide a written version of a management (or environmental) policy for their business
- the degree to which they were applying a 'systems process' to their farm management

- the application of an assessment 'process' to identify environmental issues of concern (both on-farm and in the local area)
- the use of monitoring to assess progress towards goals
- the use of some form of review process to evaluate progress
- their willingness to participate in the study
- location
- size of enterprise
- their availability for interview
- the level of development of their environmental management system or program
- the range of enterprises pursued.

Of these, 35 farms were in Australia and 5 in New Zealand. These 40 farmers were divided into two groups in this study. Twenty-three farmers were using a variety of non-formal approaches to resource management on-farm that did not include all elements regarded as 'systems' elements (called the Environmental Management Program or EMP group in this report) and 17 were using an environmental management systems approach (the EMS group). Of this latter group, 16 farmers were utilising ISO 14001 (although not all had proceeded through to certification), while the other farm was generally following the principles of this Standard through a customised 'in-house' process. Mech and Young (2001) included all approaches under the umbrella term of VEMAs – voluntary environmental management arrangements. In addition, some participants were following organic or biodynamic production practices. (Since the interviews, four of the interviewed EMP farmers have indicated that they intend to pursue use of ISO 14001, two of the EMS farmers have discontinued certification, but kept their systems running, and three of the EMS farms have undertaken certification).

It should be noted that the final group of participants was not a reflection of the entire number of farm operations in Australia with an EMS in place. Since the commencement of the project, the Joint Accreditation Scheme of Australia and New Zealand, JASANZ, has launched a database listing businesses with a registered EMS. Examination of this database has revealed more farms with an EMS certified against the ISO 14001 Standard. Details of businesses operating certified systems who have registered with Standards Australia can be found at <http://www.jas-anz.com.au/homeframe.htm>.

2.2 Interviewing farmers and farm managers

Following the final selection of participants, a full interview process was undertaken. Interviewers undertook a one-day training session prior to conducting interviews, in order to standardise the approach to interviews and to provide some background information of EMS. A team of five NSW Agriculture staff conducted the interviews with farmers.

The interviewers visited the farms, and talked with as many as possible of the staff involved in the environmental management on-site. In addition to direct conversation, supporting materials such as environmental policies, monitoring and recording data,

and any eco-labelling or marketing/promotional materials were also reviewed. The full questionnaire used in the study has been provided as Appendix 1 to this report. Thus, interviews were conducted in a semi-structured method (Denzin 1978), using an open questioning method with opportunity for participants to expand or add to questions and responses as they wished. The interviews were transcribed, with transcriptions approved by the participants. Case study stories have been previously published (Carruthers 2003b).

Lower-income participants were compensated for their time in taking part in the study.

The interviews aimed to determine the motivations that had driven the managers to adopt more formalised approaches to environmental management. Questions addressed the following issues:

- farm description, location, and history
- climate
- sources of income and mix of enterprises
- training and experience of the managers and staff (if any)
- environmental issues covered in the farm plan
- motivations for change – both from original goals and as a result of particular pressures/drivers
- management changes applied and the methods used to do so
- others management approaches being applied
- sources of information used
- indicators and monitoring used to assess change
- communication
- benefits and costs of changes to management
- marketing (if any) of changes made
- support and involvement of other parties in making changes on-farm
- perceptions regarding the role of government, industry and the community
- confidence in management
- perceptions on the future direction of management.

The two groups of farmers differed in the perspective from which they responded to the questions asked. The EMP group tended to combine information about both their environmental work and any quality assurance programs in their answers, rather than splitting the information provided. The EMS group, on the other hand, more commonly answered questions in the overall context of their EMS alone. This has created some subtle differences in the way the farmers approached and answered the questions, and needs to be considered when reviewing their responses.

In some cases, participants requested the non-disclosure of certain financial information, a wish that has been respected in the information presented here. Data from the interviews have been compiled, and this report discusses key messages, similarities, and differences in data arising from the interviews. Where appropriate, responses have been grouped.

A compilation of existing best management practices was also undertaken as part of this study. A wide range of government agencies, non-government organisations, universities and research and development organisations from across Australia were contacted and asked to provide information about any publications they produce that had a major focus on improving environmental management of agricultural industries. Additional publications for potential inclusions were also identified through searches of the web sites and publication lists of targeted organisations, in particular the department of agriculture or equivalent in each state, CSIRO and research and development organisations. Searches were also made of the catalogues of selected libraries, including NSW Agriculture and University of Sydney, and of the Australian Agricultural Research in Progress (AARIP) database. Appendix 2 more fully describes the process undertaken to collate available best management practice and code of practice documents, and contains the collation on a state-by-state basis

3. Results

3.1 Range of enterprises included in the study

The mix of enterprises on the case study farms is shown in Table 1. Those in the ‘mixed’ category had several enterprises, usually a mix of livestock and cropping, but in some cases, other combinations included agroforestry, essential oil production, and horticulture with either livestock or cropping. The final list of participants included farms with single operators through to large corporate ventures. Of the EMP participants 83% regarded themselves as family farms and 17% as corporate farms. Of the EMS participants, 59% classed themselves as family farms and 41% as corporate farms.

Table 1 Case study enterprise mix

Enterprise Type	No. of Farms	No. using EMS
Wine	3	2
Aquaculture	2	2
Mixed enterprises	8	3
Intensive livestock (poultry, pigs, feedlots)	6	2
Extensive livestock (dairies, beef and sheep)	6	2
Horticulture (fruit, vegetables, essential oils and nursery)	12	4
Broadacre (rice, cotton, grains)	3	2

The farms ranged in size from 1 ha to 3789 ha in the EMP group and from 30 ha to 6000 ha in the EMS group. Farmers in both groups were sometimes operating more than one farm within their overall business structure.

3.2 Farmer and farm characteristics

Most participants had been full-time farmers for most of their lives. In the EMP group, 22 had many years of farming experience. One member of this group had been farming full-time for less than 10 years, but had spent time before this working as an agronomist. Five other members of this group reported that they had followed other careers before moving into full-time agricultural management. Secondary manufacturing, mining, environmental and marine management, accountancy, and teaching were the careers followed by these individuals. In addition, one of the EMP farmers worked full-time as a journalist, but had been involved in agriculture all his life.

In the EMS group, all participants reported that they were full-time farmers or farm managers: seven also had past experience with other careers, including research with CSIRO, a director for a research and development corporation, engineering, agri-business sales, electrical trade, hospitality, management/administration, and service in the armed forces. One of the participants in this group had only been full-time in agriculture for 2.5 years at the time of interview, while the other farmers had agricultural careers of between 10 and 40 years.

The EMP group more commonly reported off-farm income (57%) than the EMS group (35%), with 43% of the EMP and 41% of the EMS group reporting that all income came from the farm. However, four members of the EMS group (24%) did not answer this question. These four were all corporate farms, and so it could be postulated that company structures did generate income from a range of areas. If this group were added to the EMS group reporting off-farm income, then similar percentages in both groups would report off-farm income (57% EMP and 59% EMS). If however, all income was derived from agricultural pursuits in this group, then 65% of the EMS group would be reporting that all income was derived from farming, substantially more than that reported by the EMP group.

The amount of off-farm income reported ranged from approximately 5% to over 80% of total income. In some cases, this income came from spouses working off-farm, but for others, was generated by earthmoving or farm contracting work (fencing, harvesting, weed control and similar activities), shares, and other investments.

Approximately 30% in both groups believed that there were endangered or threatened species either on or near the farms. Of the EMP farmers, 61% stated that there were environmentally sensitive areas on their farms. Slightly more EMS farmers (71%) reported such areas. For the EMP group, on-farm remnant vegetation was most frequently reported as being an issue, with the EMS group more frequently nominating on-farm wetlands, riparian zones, creek/rivers and Aboriginal or heritage sites (all at 24%) as sensitive areas (see Figure 2a).

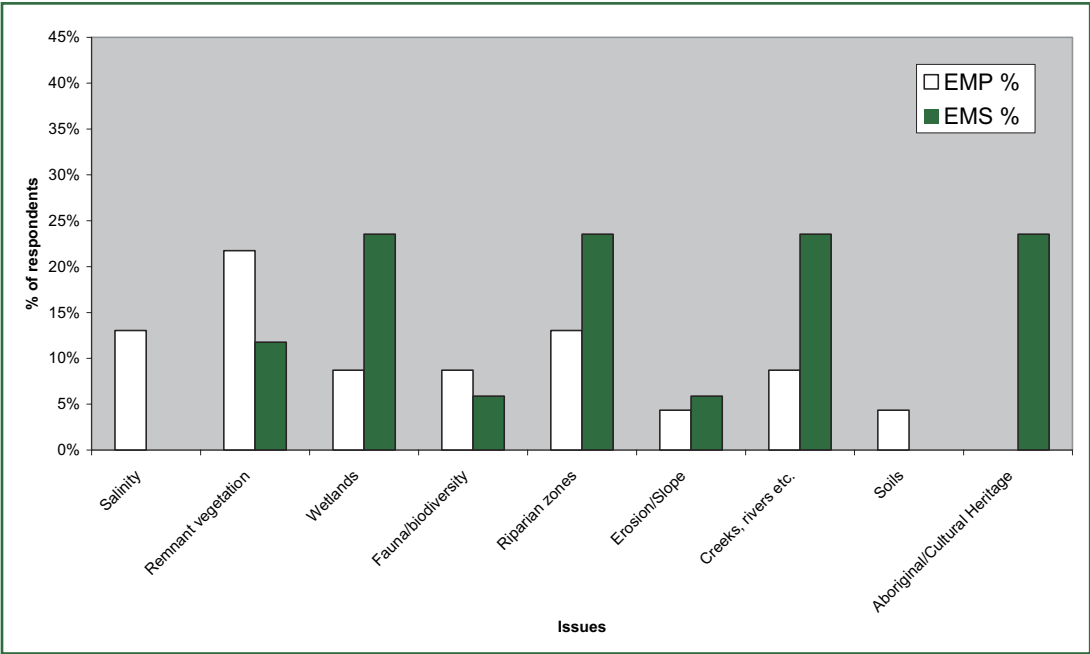
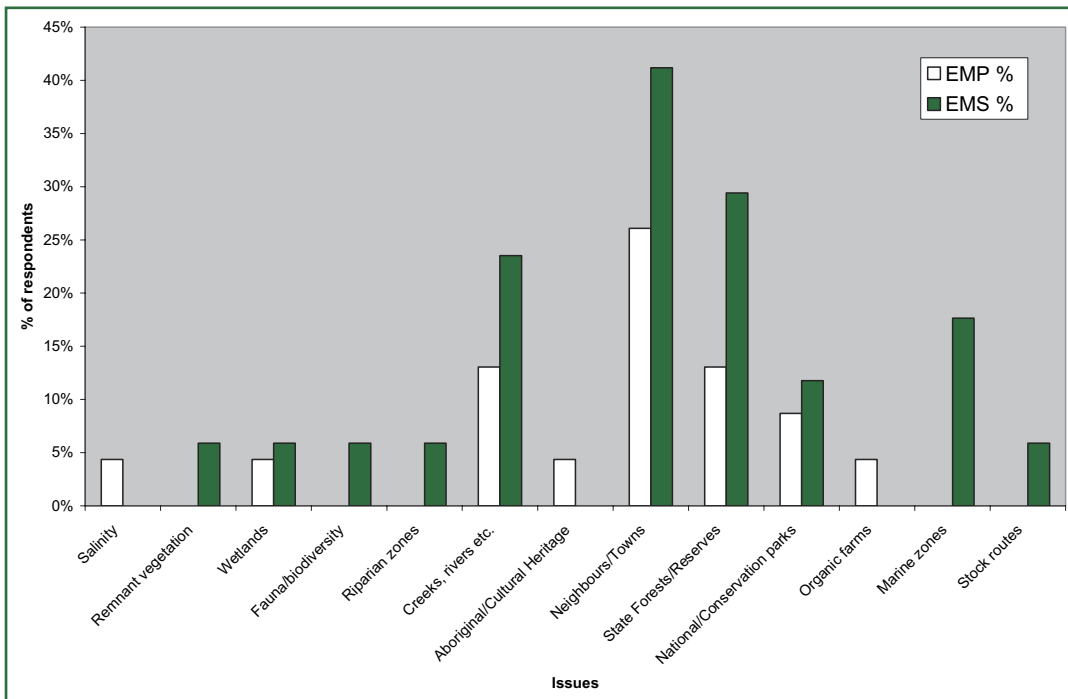


Figure 2a Environmentally sensitive issues on-farm

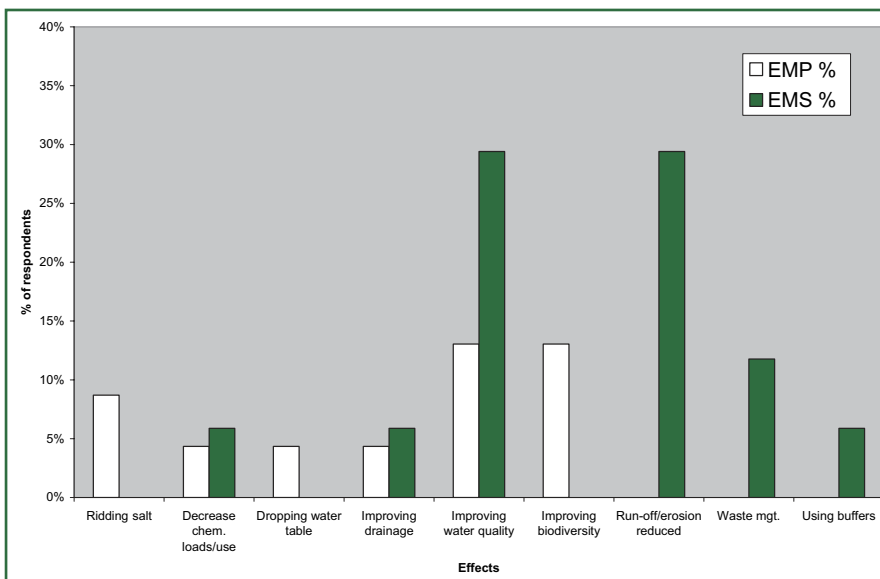
Off-farm, both groups reported neighbours/houses most frequently as environmentally sensitive sites (EMP 26% and EMS at 41%). However, a range of other sites surrounding the farms was also reported as being environmentally sensitive (Figure 2b).



The positive and negative effects that farmers felt they, and other farmers, were having on the catchment as a result of their farming activities are shown in Figures 3a and 3b. Approximately 25% of farmers in the two groups believed their environmental management was having a positive effect in the catchments surrounding their farms, with the same percentage believing that they were having a negative effect.

Figure 2b Environmentally sensitive issues off-farm

The most commonly reported positive effects of farm management on catchments, reported by 13% of the EMP group, were improving water quality and improving



biodiversity, with another 9% stating that they were removing salt from the area. Single farmers in this group also mentioned decreased chemical load or use, lowered water tables and improved drainage.

Improved water quality and reduced run-off and/or erosion was reported most commonly by the EMS group (29% for both issues), with 12% mentioning improved waste management. Single farmers in this group also discussed decreased chemical use, improved drainage, and use of buffers as positive effects on the catchment.

Figure 3a Positive effects of farm management on catchment

Many of the negative effects of farm management on surrounding catchments reported were described as potential, rather than actual effects that had been occurring. Some farmers stated that one of their aims in changing practices was to quantify what, if any, effects they were actually having on the catchment. Several farmers in both groups expressed frustration at not having clear targets or indicators relevant to the farm scale against which to measure progress or otherwise in their performance concerning catchment management.

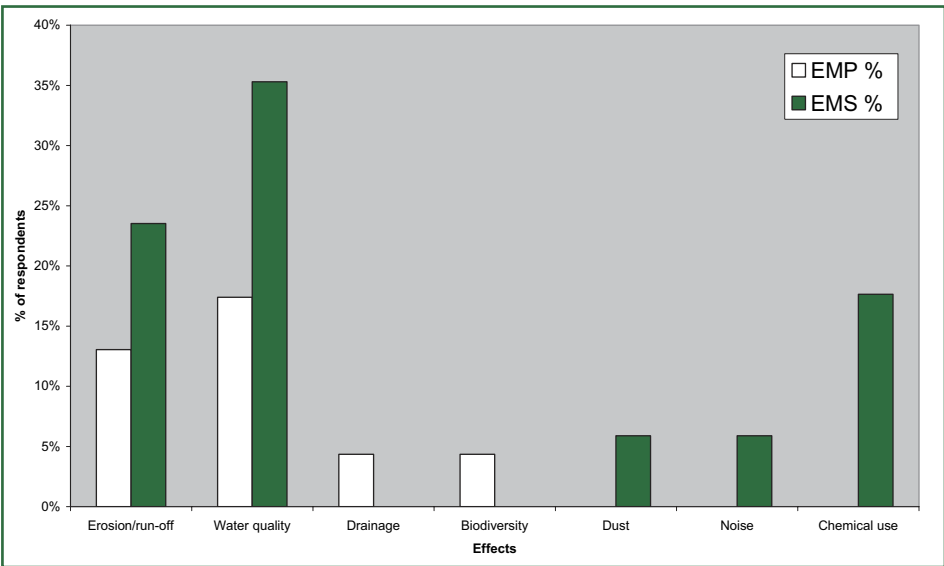


Figure 3b Negative effects of farm management on catchment

Both groups reported impact on water quality as the most common effect their activities were causing (17% EMP and 35% EMS). Erosion was raised as an off-farm impact by three EMP and four EMS farmers. Single EMP farmers discussed effects of drainage and biodiversity, and single EMS farmers cited noise and dust. The EMS group also suggested impacts arising from chemical use in approximately 20% of cases.

Only one EMP farmer stated that catchment management in the whole area was having a positive effect on their farm. Approximately 40% of the EMP and 25% of the EMS farmers stated that catchment management practices had no effects on their farms. Farmers in both groups believed that the management practices of other farmers and others in the catchment were having negative effects on their farms, with 52% of the EMP and 76% of the EMS farmers raising these concerns. The effects that were believed to be occurring are shown in Figure 3c. The EMS group raised nearly twice as many negative impacts as the EMP group caused by catchment use activities.

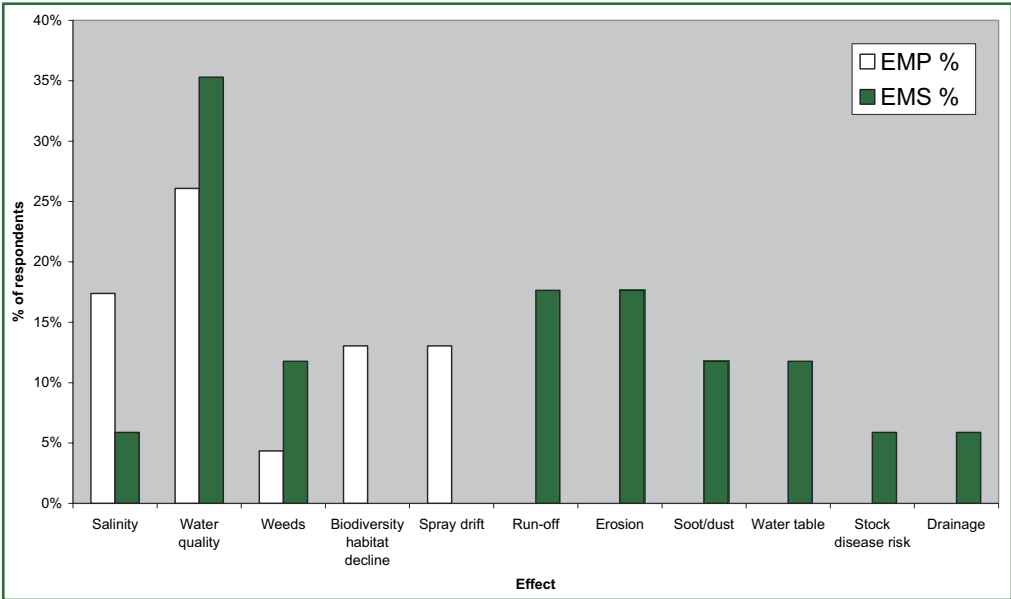


Figure 3c Negative effects of catchment management on farms

Adverse impact on water quality was the issue of greatest concern, according to 26% and 35% of the EMP and EMS farmers respectively. Salinity was the next most frequently raised issue amongst the EMP group (17%), and 13% of this group mentioned biodiversity and spray drift. The latter two impacts were not raised by the EMS group. A single EMP farmer raised weeds as an issue.

Only the EMS group raised problems of run-off and erosion (18%), soot/dust

pollution, water table changes, and weed problems (12%) as negative impacts of catchment management on their farms. Salinity, stock disease risk and drainage were of concern to individual EMS farmers.

Farmer and staff education

Figure 4 shows the highest level of education reached by individual farmers or managers and Figure 5 shows that of staff. Each group reported similar numbers of farmers undertaking some form of tertiary education. No major differences appear between the two groups in terms of education, however, farm staff in the EMS group more commonly held degrees (17% EMP and 41% EMS).

Both the EMP and the EMS groups reported undertaking a range of training associated with farm planning or related issues (Figure 6). Similar numbers of farmers in each group

reported undertaking chemical user training and marketing training. More farmers in the EMS group had completed computer and financial training than the EMP group, and more than twice as many EMS farmers reported that they or staff held a degree in response to this question. Single instances of environmental, business and ISO-based management systems training were also reported in the EMS group. Single instances of Holistic Resource Management, risk management, OH and S, quality assurance, train-the-trainer, Piggery Environmental Management, Community Development and a Masters of Business Administration training were reported by the EMP group. The EMS group undertook more ‘business-related’ training than the EMP group (computer, financial and business management)

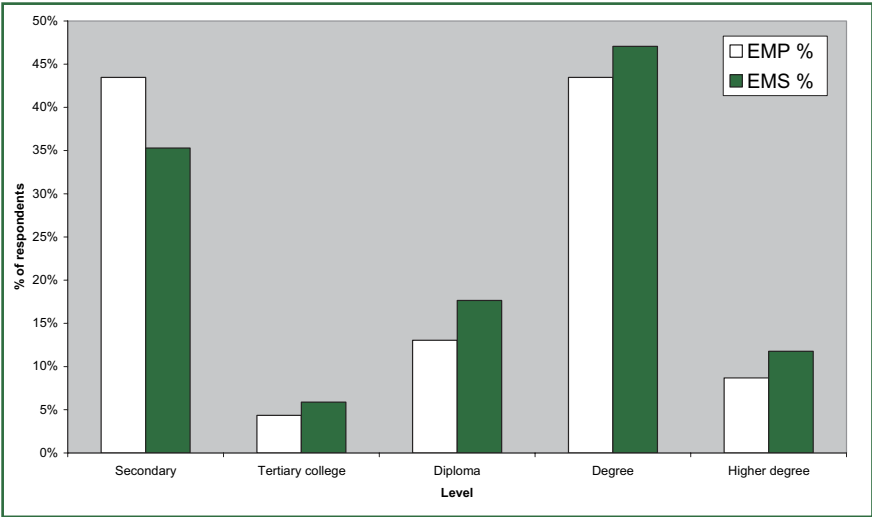


Figure 4 Education level reached by farmer/managers

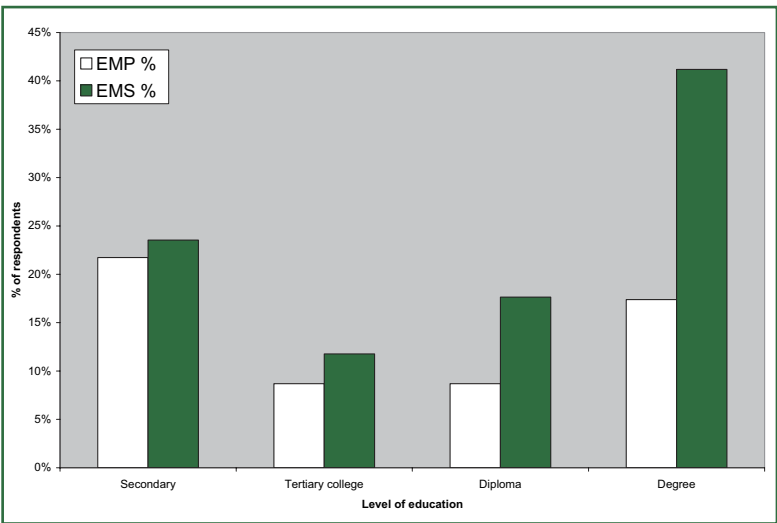


Figure 5 Education level reached by staff

but, as the sample size is not large, these differences may not be significant. Cary et al. (2001) suggested that undertaking property management planning training was an important factor in addressing concerns farmers might have had about farm planning, and in promoting adoption of PMP. It is likely that a similar phenomenon will occur with EMS training, where training may reduce some of the uncertainty associated with undertaking a new management approach.

Membership of groups

Membership of industry and community groups was mostly similar in both categories of participants (Figure 7). Over 70% of both groups were members of an industry group. Approximately half of the EMP farmers indicated involvement in research, and around 40% in Landcare, catchment management and ‘other’ groups. More EMP farmers were involved in research, market, and focus groups while the EMS farmers were more commonly members of Landcare and catchment management boards (around 50%), and ‘other’ groups (approximately 70%). ‘Other’ groups included local councils’ environmental/ sustainability groups, local water users committees, community groups, biodiversity issues groups, Cooperative Research Centre focus groups, and industry-related groups. These results may indicate that the EMS farmers were taking a wider community view of resource management, while the EMP group was more likely to focus on market/production related issues, although the small sample size means that it is difficult to determine definitive results.

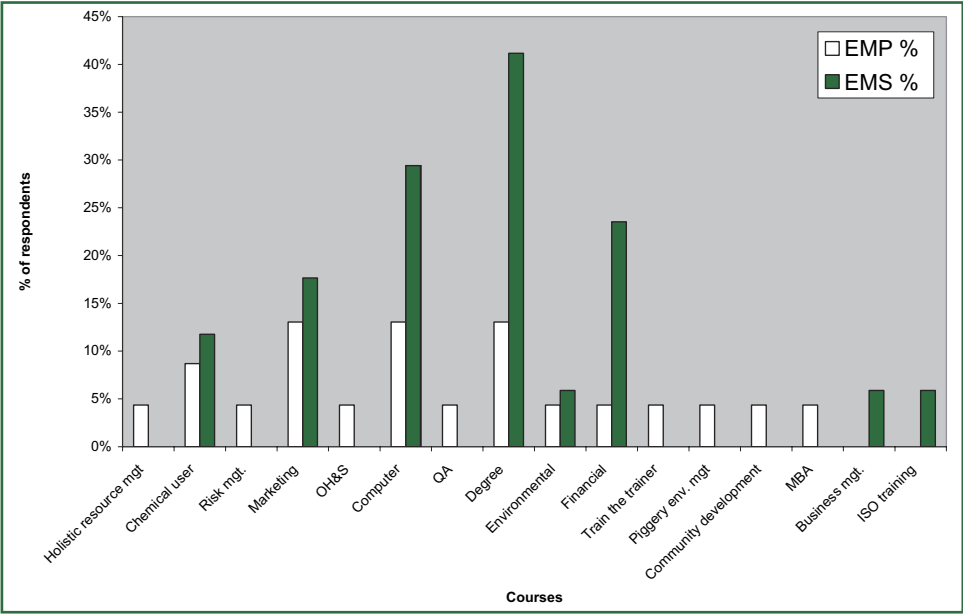


Figure 6 Related farm-planning training

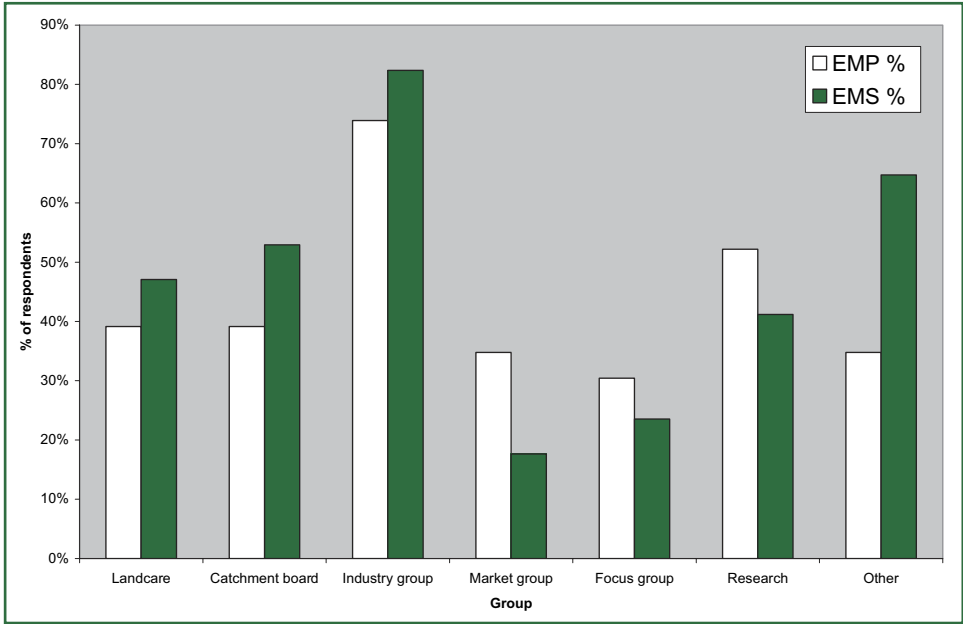


Figure 7 Membership of groups – farmers or staff

Markets and their influence

Markets for farm produce for both groups are shown in Table 2. A greater proportion of the EMS group reported having international markets, with Asia the most common destination. Andrews et al. (2001) reported that 76% of the EMS businesses they studied had overseas customers and that medium-sized enterprises were more likely than smaller businesses to be concerned about international markets rather than domestic customers. Knowles and Hill (2001) reported that all six of the large South African wineries they surveyed had received environmental enquiries from buyers, agents or ‘interested’ parties; whereas only four of the ten small wineries in their study had received such enquiries. These enquiries came mostly from EU countries. As the EMS group contained a higher proportion of ‘corporate’ level farms, it is possible that they are operating under a different set of market pressures (arising from a different customer base) than the EMP group. Market pressures had influenced changes in farm management for 52% of EMP and 35% of EMS farmers in the current study.

Table 2 Market destination for farm produce

Markets	No. of respondents – EMP group	No. of respondents – EMS group
Domestic	21	11
International	17	16
Asia	14	13
Europe	7	6
USA	4	4
UK	4	4
South America	1	0
Middle East	0	1
New Zealand	0	1
India/Sri Lanka	0	1

Several of the EMS farmers mentioned Japan as a specific market requesting environmental credentials. Pressure from supermarkets in the UK was cited as a reason for adopting increased environmental management by both groups. Knowles and Hill (2001) reported a similar trend, citing requests from agents of large UK supermarkets as providing most of the demand for ‘green credentials’. They further stated that ‘South African wineries supplying EU markets must address the growing demand for ‘environmental integrity’ from that market sector’. Both groups (13% of EMP and 24% of EMS) nominated market or customer concern as a ‘crisis’ that stimulated management changes.

When asked about market signals, 74% of the EMP and 65% of the EMS farmers indicated that they were getting market signals about being ‘clean and green’. Of those responding to this question, 29% of the EMP farmers said these messages were ‘clear’, and 47% said they were ambiguous. In the EMS group, 64% felt the messages were clear, and 36% felt they were ambiguous. Japanese markets were again mentioned by both groups as being discriminating in purchasing choices, on both food safety and environmental grounds. From this study it appears, therefore, that the EMS group was receiving clearer market messages about environmental management than the EMP

group, and was also exposed to a more international market place. This corresponds with the finding of Andrews et al. (2001) as detailed above.

3.3 Environmental policy statements

The NSW EPA reported that only 6% of small businesses had an environmental policy or program (NSW EPA 1995). Williams et al. (2000) reported that 86% of companies they surveyed did not have any form of environmental plan, with 73% not having an environmental policy, either. In contrast, in this study, just over half of the EMP farmers had some form of written policy or vision statement. In 17% of cases, this statement was incorporated into overall farm business plans and did not deal specifically with environmental issues or their management. Some of these farmers had incorporated environmental policy statements into specific licence requirements, and had developed the statements only to meet these requirements.

Finally, several farmers in this group had also developed policy statements on specific environmental issues, to meet the requirements of the Natures Choice program (i.e. these farmers had a 'water use' policy, a 'chemical use' policy, a 'soil management' policy and so on).

All of the EMS farmers had a written environmental policy statement, although some indicated that they felt these policies were 'drafts' rather than final documents. These policies were available to the public on request, and were sometimes sent to customers, regulatory agencies and others. In many cases, these policies also incorporated wider business objectives and formed part of the overall approach to management.

Metzenbaum (2001) reported that in a number of industrial enterprises, disclosing goals to the public enhanced the likelihood of environmental outcomes being achieved. Documented policy statements of environmental intent of farm managers, therefore, may serve both as an effective communication tool and a stimulus to achieve the stated outcomes. Cary et al. (2001) suggested that having a property management plan may be a consequence of better management and proactive attitudes, rather than these factors causing a farmer to develop a plan.

Thus, while both groups of farmers can be seen as similar in terms of education and farming experience, more of the EMS farms were described as 'corporate' and these were somewhat more likely to have more staff with tertiary training than the EMP farms. Many studies have found that farmers are more likely to adopt changed practices when they are financially secure, so the early adoption of EMS by a group which included many corporate farms is perhaps not surprising. It could also be that these farms had a greater customer pressure to adopt demonstrable environmental management practices, due to the greater proportion of international markets.

3.4 Initial goals when beginning to farm and what has changed

Cook and Berrenberg (1981) discussed how attitudes held by farmers can determine their behaviour toward adoption of conservation practices. To determine if the two groups had differed in their initial attitudes to environmental and resource management, farmers were asked about their initial goals when they started their farming careers. About half in each group stated that they had a focus on environmental issues from the outset (57% EMP and 47% EMS). However, 39% of EMP and 47% of EMS farmers stated that they had not placed a major emphasis on environmental issues when they began.

When asked about initial goals 30% of EMP and 41% of EMS farmers nominated greater productivity and/or income. One EMP farmer and approximately 30% of the EMS farmers stated that sustainability had been a key initial focus, and only EMS farmers (18%) raised efficiency of farm operations. One EMP and two EMS farmers stated that good community relationships and quality products had been initial goals. The ability to trace products back to the farm was raised by a single EMS farmer. A desire to have a 'showcase' or 'the best farm' was the initial goal of two EMP and one EMS farmer. Single EMP farmers also raised revegetation, reducing nutrient loads, retaining supplier status, and increasing farm size as initial goals.

When asked if they felt their initial goals had been achieved, farmers in both groups answered similarly (65% EMP and 59% EMS saying goals had been achieved). One EMP farmer felt that his initial goals had not been achieved at all, indicating the goals had been unrealistic and could never have been achieved. Around 30% of both groups felt that they had partly achieved their goals, recognising that things had changed along the way. Both groups frequently acknowledged that environmental management would be an on-going commitment in their total farm management. Two EMS farmers did not answer this question.

Had goals changed over time?

Goals had changed over time for some farmers, with approximately 60% in both groups reporting a change. When responses as to how goals had changed were collated (percentages were calculated only for those who indicated that a change in goals had actually occurred), 50% of EMP and 40% of EMS farmers indicated that environmental matters were increasingly included.

For the EMP group, increased production, increased sustainability, lowering inputs, and increased biodiversity were new focus areas for two farmers each (14%) and single farmers also nominated food safety and integrated business management.

For the EMS group, 40% reported an increased focus on integrated business management and management tools and single farmers also stated that increased production, enhanced sustainability, decreased inputs, and enhanced market access formed part of their new goals.

What prompted changes in goals?

For the two groups, a range of drivers to change goals was reported. These were both extrinsic and intrinsic. When asked what factors had caused their goals to change, self-choice was the most frequently nominated factor (87% of EMP and 76% of EMS farmers). Where farmers nominated more than one factor as influential in changing goals, self-choice was usually stated to be the strongest. Public opinion and stakeholder pressure were nominated by four EMS farmers as reasons to change goals – these factors may also have affected the degree of ‘self-choice’. Several farmers in both groups stated that they wanted to ‘do the right thing’ and ‘to settle their own consciences’ with regard to environmental management.

Markets were the next most commonly nominated factor, with 35% of the EMP and 41% of the EMS group citing this. Market factors were also of importance when determining specific management changes (see below).

Regulatory pressure was reported in only 17% of EMP and 18% of EMS cases. While relatively few farmers nominated this factor, the EPA was the most frequently mentioned regulatory agency in this regard (three EMP and two EMS farmers). Regulatory pressure was more commonly reported by those in the intensive livestock enterprises (pigs, poultry, feedlots and aquaculture), and was often linked to specific monitoring programs and reporting conditions for licences.

None of the participants reported moving out of enterprises because of regulatory pressure, but one of the EMS farmers did indicate that regulatory drivers and the need to acquire a licence had been a major motivator in seeking EMS certification. Single farmers nominated OH and S requirements (EMP group) and water licensing requirements (EMS group) as regulatory areas that created a change in goals. Regulatory pressure was, however, more important to the EMS group when it came to selecting issues to address on-farm (see below – ‘Identification of issues’).

Thus, for agriculture, regulation does not appear to be a significant factor in changing goals, in contrast to the results for secondary industry reported by Andrews et al. (2001), where regulatory compliance was the greatest motivational driver for EMS adoption. The results of the current study suggest that, for agricultural enterprises, increased regulation may not result in improved environmental outcomes, without some form of awareness raising program, as farmers may simply not be aware of their obligations.

Self-choice, public opinion and access to markets appear to be more important in affecting farmer goal-setting behaviour. The EMS group, however, did differ in that around half of that group was now increasingly focused on integrated management practices.

3.5 Changes in management practices

Market pressures

Market pressures influenced 52% of the EMP group for on-farm management changes, with quality assurance and food safety issues being the most commonly cited reason for making these changes. This group specifically mentioned UK supermarkets, especially in relation to the Natures Choice programs. Of the EMS farmers, 35% stated that market pressures had influenced specific management practices on-farm. This group specifically mentioned Japanese markets and the requirements for quality assurance as a driver for change.

Some farmers indicated that they had adopted EMS or EMP as a way of differentiating their products in the market place. Many noted that customers or buyers had been primary drivers for adoption of improved environmental management. Corbett et al. (2003) reported that customer pressure was lower for ISO 14001 adoption than ISO 9000. One of the difficulties in comparing ISO 9000 and ISO 14001 implementation is that it is far easier to measure pressure from customers and consumers than it is to evaluate 'environmental' pressure. Lack of agreed parameters on environmental conditions and consistency in measurement are only two of the problem areas in this evaluation. Identification of the 'customer' for environmental stewardship is also problematic – should community, regulatory bodies, neighbours, or some other group be given precedence when setting targets?

Some farmers had developed environmental labels or brands and had embarked on specific marketing strategies for their products. Those who proceeded to certification of an ISO 14001 system could use the certification companies' proprietary EMS identification to indicate that there is an EMS in place. Examples of this include the five white ticks on a green background square from SAI, or the Green Dove logo from SGS International Certification Services Pty. Ltd. These symbols, however, cannot be used as product labels, as gaining certification to ISO 14001 does not confer any product differentiation per se. Assured supplier status was obtained in some cases (although this was often linked with a particular QA program, with the improved environmental management adding to the overall 'green' package). Independent auditing and certification were usually undertaken to verify these market demands.

Thus there appear to be no major differences between the two groups in their initial attitudes towards the environment, with around half of each group stating that the environment was of concern to them when they began farming. Additionally, similar numbers of farmers in both groups indicated a shift in the focus to more environmental management over time. However, the EMS group was more likely to raise the sustainability and efficiency of their operations as initial areas of concern, and also indicated that a more integrated approach to management was desirable.

3.6 Motivations for changing management practices or adopting EMP or EMS

The motivations and drivers for enhanced environmental management on-farm were examined in this study in order to determine if there were any distinguishing factors between the two groups.

Past research of adoption of changed environmental practices in other industry sectors has revealed a range of motivations. Perception of personal threat is a strong predictor of adoption of environmental practices (Baldassare and Katz 1992). While some environmental factors addressed in farm management might be seen as 'personal' threats, in terms of impact on personal/family health and safety, others were more to do with economic issues. For example, grain growers in Western Australia began to investigate the use of EMS partly in an attempt to capture market benefits and product differentiation (Weeks 2003). Interestingly, these farmers originally rejected the use of ISO 14001, intending to develop their own approach, but came back to using the Standard as a guide as it provided both flexibility and a management framework within which they could fit their own aspirations (Weeks pers. comm., 2003).

Florida and Davison (2001) examined motivations for adoption of environmental initiatives amongst businesses with EMSs, pollution prevention programs or a combined EMS/pollution prevention approach. Regulatory compliance and costs savings were equally rated (100% of all businesses in the study). Self-motivation, improved business performance, community concerns and customer relations were the next most highly ranked concerns.

South African companies (Alheit and Keogh 1999, cited in Knowles and Hill 2001) were motivated to invest in EMS by stakeholder pressure, public perception and regulatory compliance pressure rather than by internal factors such as the desire to increase efficiency of resource use or to achieve cost savings. However, the use of EMS as a potential marketing advantage was not raised as reason to implement an EMS by the South African wineries studies by Knowles and Hill (2001).

In a study conducted by Andrews et al. (2001), enterprises ranked their top seven motivations to adopt EMS thus:

- improved environmental performance
- consistency with personal/management principles
- compliance
- employee participation
- cost reduction
- regulatory benefits
- competitive advantage.

Similar findings were reported in one of the few studies so far that has examined use of EMS in Australia and New Zealand. Corbett et al. (2003) reported environmental improvement and corporate image as the two chief motivators amongst secondary

industries in Australia and New Zealand for ISO 14001 adoption. In South Africa, large wineries considering implementing EMSs were motivated by past experiences of serious environmental incidents which sometimes resulted in regulatory requirements for the development of environmental plans. On the other hand, smaller wineries reportedly stated that they would wait until 'forced' by markets to implement an EMS (Knowles and Hill 2001). Corporate image is unlikely to be a major concern for primary industries in Australia, except perhaps for farms owned by large agri-business or other companies. However, public opinion did appear to be a factor influencing goal-setting amongst EMS farmers.

For secondary industries at least, compliance may be seen as a major motivational force for EMS adoption. While fear of increased regulation is a commonly expressed concern amongst the farming community, in reality, many farmers do not currently actively address regulatory compliance issues in their day-to-day activities. Additionally, they are relatively unaware of the exact details of regulatory compliance required from them. This lack of familiarity with details of compliance may, in fact, promote the fear of regulation. Therefore, it is reasonable to suppose that regulatory drivers and desire for compliance would not form a major motivational factor in adopting enhanced environmental management or specific practices, although it may form a general driver through 'fear'. A desire for environmental improvement, efficiency of operations, improved market access and/or premiums and ease of management may be more specific key motivational factors.

Specific drivers for improved environmental management

A number of motivations for EMS and EMP adoption on farms was evident among case study participants (as has been the case with EMS adoption in the secondary industries – see Darnall et al. 2000; Nash and Ehrenfeld 2001; and Florida and Davison 2001). Drivers/motivators, cited in terms of either a 'crisis' or a major stimulus, for adoption of natural resource management approaches by case study participants are shown in Figures 8 and 9 respectively.

In general, farmers in the current study indicated that personal desire to improve the sustainability of the farm, and ensuring the health of both personnel and resources were prime drivers. This was often coupled with the observation of degraded resources on-farm and the desire to pass the farm on to family members in an improved state. Individual motivation is a powerful driver to harness in natural resource management, as it is only through changes in individual behaviour that solutions to environmental issues can be achieved on a larger scale (Zelezny and Schultz 2000).

Crises stimulating changes from previous management

Farmers were asked if there had been any particular crisis that had prompted them to change their management practices, or whether the changes had occurred slowly over time (Figure 8). Nearly half of the farmers in both groups indicated that there had been no specific crisis, and that the changes had taken place gradually because of their own personal choice. Relatively few farmers in either group described changes as occurring due to a ‘crisis’. Salinity had been the crisis that prompted 17% of the EMP farmers to change, and market/customer demands in 13% of cases. “New development” (presumably linked to licensing requirements) was a ‘crisis’ for two farmers, with another six issues raised by single farmers in this group. Concern about native vegetation, the ‘value’ of water, and ‘fear of sprays’ were other specific resource issues raised.

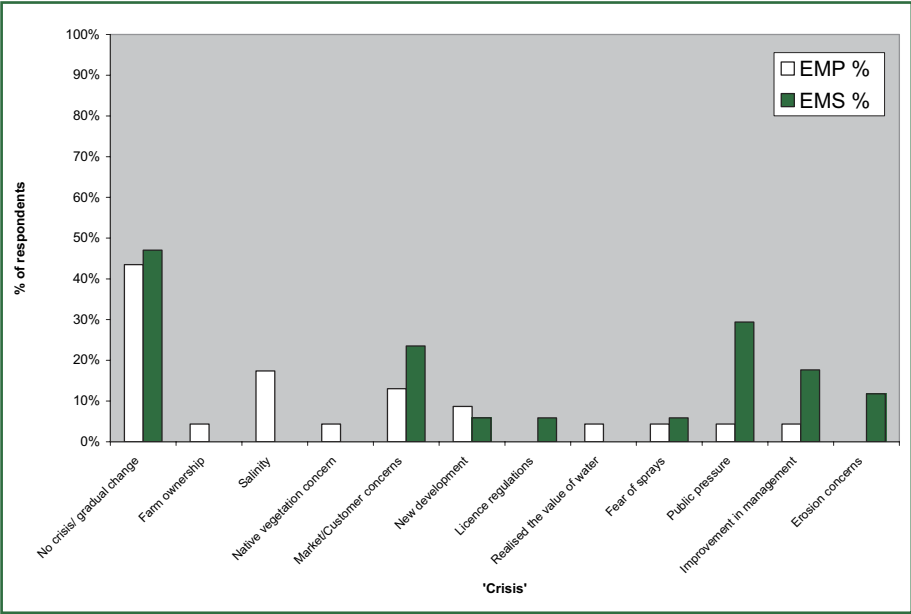


Figure 8 Were management changes made due to a crisis and if so, what was it?

The EMS group cited public pressure/concern about agriculture (29%) and markets/customers (24%) as crises that stimulated changes. This is similar to the findings of Hilary (1999) where SMEs reported that customer concern was the major driver for EMS implementation, and those of Andrews et al. (2001) who reported that market-focused organisations (which farms essentially are) were more strongly motivated to adopt EMS by a desire to improve environmental performance than by regulatory concerns. Other farmers in the EMS group were driven by a need for improved farm management (18%), erosion control (12%), and three other areas raised by single farmers. ‘Fear of sprays’ was the only other specific resource condition mentioned by the EMS group.

In general, EMS farmers appeared to be more concerned with the public image of their industry and market pressures and more responsive to perceptions held by the community regarding agricultural practices, than the EMP group were.

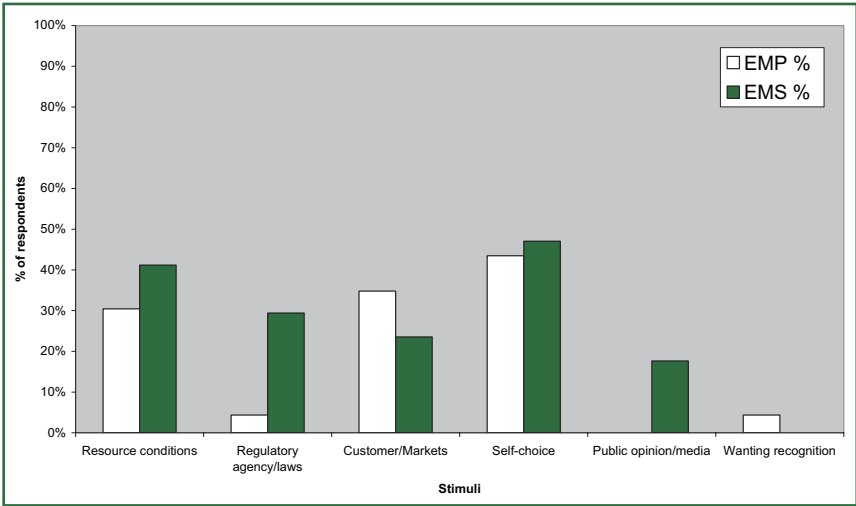


Figure 9 Major stimuli for change

Stimuli for change from previous environmental management

Farmers were asked to nominate factors that had pushed them into making changes, as distinct from being 'forced' to change as a result of a particular crisis. Self-choice was again the major factor prompting 43% of EMP and 47% of EMS farmers to change (Figure 9).

In contrast to the 'crises' detailed above (where customers/markets were only raised by three EMP individuals), 35% of the EMP group nominated customers/markets as the second highest motivational factor in changing practices, with resource conditions third (30%). Single farmers in this group also nominated regulatory agencies and/or laws and the desire for recognition of work as motivational factors. Market destination and enterprise type may be a factor here, with Knowles and Hill (2001) postulating that niche markets may not experience the pressure to have EMS/ISO 14001 that large markets may exert (the reasoning being that niche markets are already established on some point of difference, with consumers prepared to preferentially source and purchase these products without further differentiation on environmental or other grounds).

For the EMS group, resource conditions were the second highest mentioned factor (41%), with EPAs or regulatory agencies third (29%). The influence of markets and customers was slightly lower, at 24%. These results differ somewhat from those described as 'crises', where approximately one-third of the EMS group nominated market pressures as a 'crisis', with only one instance of a regulatory requirement (licence regulations) being raised.

The condition of the resource base was another significant issue contributing to farmers' adopting changed practices. However, only 4 specific resource management issues were nominated by single EMP farmers. These issues were erosion, drainage, salinity, and water allocations. For the EMS farmers, erosion was cited in 24% of cases as the major issue driving change, with single mentions of water allocations, soil conditions, flooding, the increasing need for inputs, and a desire to be more 'sustainable'. Several farmers in both groups indicated that the issues addressed within farm management had often been included specifically so that they would not become 'crisis' issues.

Regulatory pressure was therefore a motivational factor for EMS farmers, but of less concern than resource conditions. This is an interesting result, as more of the EMP farmers participated in intensive livestock industries, which might be expected to be subject to greater regulatory scrutiny. It could be that the EMS farmers had a greater focus on regulatory issues as a result of following the ISO 14001 Standard, which requires farmers to not only be aware of, but also to commit to, conformance with all relevant legalisation and regulations, industry codes, and similar documents. Hilary (1999) reported that legislation and regulation were more important drivers for general environmental improvement than were customers in EMS adoption. Florida and Davison (2001) reported that, in their study, state regulatory requirements were slightly

more commonly reported than federal regulatory requirements as drivers (85.5% to 83.9% respectively).

The EMS group indicated that public opinion and media pressure was a motivating force in a small number of cases, with 18% of farmers citing this as a reason they changed practices. Speir (2001) reported that the desire for recognition of good environmental management can be a motivator, and that this need for recognition can be met in many ways.

Some farmers were able to specify where the market pressure had come from. The EMP farmers cited the Natures Choice program (two farmers), supermarkets, export markets, and customers in general (all single cases), while the EMS group listed 'general customers' (two cases), export markets and government customers (both single cases).

3.7 How were changes to environmental management made?

Funding for environmental works

Farmers in the two groups used a variety of sources of funding to support the environmental works they undertook. However, this funding was usually limited to fencing or revegetation, and only in a few cases did the funding cover the 'systems' area of management, such as auditing and assistance with documentation and monitoring. Specifically, two farmers in each group reported that assistance had been received for environmental self-assessments, audits, and/or systems/planning development. These farmers were involved in either the Natures Choice (EMP group) or the NOSLaM (EMS group) programs in New Zealand.

Around 60% of the EMP farmers had received outside funding to assist with improved environmental management, with the greatest contributor being the state governments (29% of those who received any funding). Other sources of funding included Natural Heritage Trust, Landcare, the general community, research projects (two cases each), Salt Action, the Natures Choice/Field Fresh program, the federal government, Catchment Management Authority, Rivercare, the KiwiGreen program, Queensland Fruit and Vegetable Growers Association and state Forests (all single cases).

Just over half (53%) of the EMS farmers received outside funding to assist with resource management. Four farmers in this group did not answer this question. State governments provided funds for 44% of those answering this question, with the federal government, the Natural Heritage Trust, and a New Zealand community/EPA/local council conglomerate (the North Otago Sustainable Land Management group, NOSLaM) the source of assistance for two farms each. Local catchment management groups/centres, and Greening Australia, CSIRO and a native vegetation covenant agreement had each provided funds for works on individual farms.

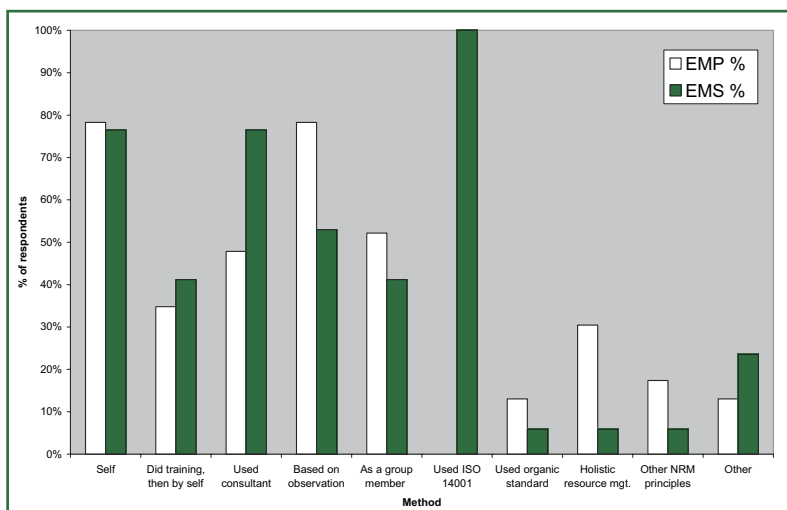


Figure 10 How were changes to management done?

group membership (52% EMP and 41%EMS) when developing changes to practices. However, it is likely that the ‘group development’ option for environmental change was not available to EMS farmers. At the time of the study, EMS was generally being pursued by individuals alone, with little or no industry involvement such as currently occurs for more production-focused development areas. Industry based ‘focus’ groups had not begun to use the EMS process, nor were extension or support officers available in all areas to assist with EMS development. This situation has subsequently begun to change, with several industry sectors promoting EMS implementation on-farm.

More EMS farmers made use of consultants than EMP farmers when making changes. In just over 30% of cases for EMS farmers, these consultants were used specifically to assist with the development and design of the EMS (see Figure 11). Approximately half of the EMP farmers and around 30% of EMS farmers used consultants for advice on technical issues.

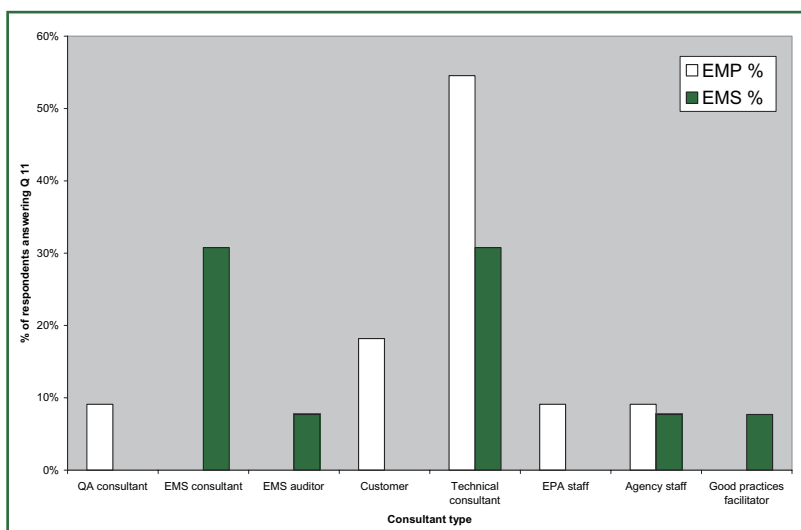


Figure 11 What sort of consultants helped with changes?

Australia available to farmers at the time of this study.

Methods of change

Approximately 75% farmers in both groups had developed their own approaches to management (Figure 10). Seven EMS farmers undertook training before making changes, as did eight EMP farmers. The entire EMS group had used ISO 14001 as a guide to change, although one member of this group did not fully apply all parts of this Standard in their EMS development, instead relying on a loss control approach developed specifically for the business.

The EMP farmers more often reported that they relied on individual observation (78% EMP compared with 53% EMS) and on

The EMS farmers more frequently reported using Best Management Practices, Codes of Practice or similar information (82%) when developing their environmental management on-farm than EMP farmers (61%). In addition, of the BMPs or similar documents used by the EMS group, a higher proportion related to environmental issues (79%) than to quality management (21%). In the EMP group, 57% of the BMPs or similar documents related to environmental issues and 35% to quality management. Appendix 2 of this report contains a listing of environmentally related BMPs, COPs, and other information in

Approximately 25% of farmers in both groups used industry codes of practice for guidance when making changes. Figure 12 shows the range of BMPs or similar that was reported as being used by the two groups. Consistent with the higher use of quality assurance systems approach by the EMS group, more EMS farmers reported using QA approaches than the EMP group. The EMP group reported using a wider range of BMPs/ COPs (with one farmer also using a HACCP approach). However, only single EMS farmers reported using either regional codes of practice or catchment management plans in developing their management approaches.

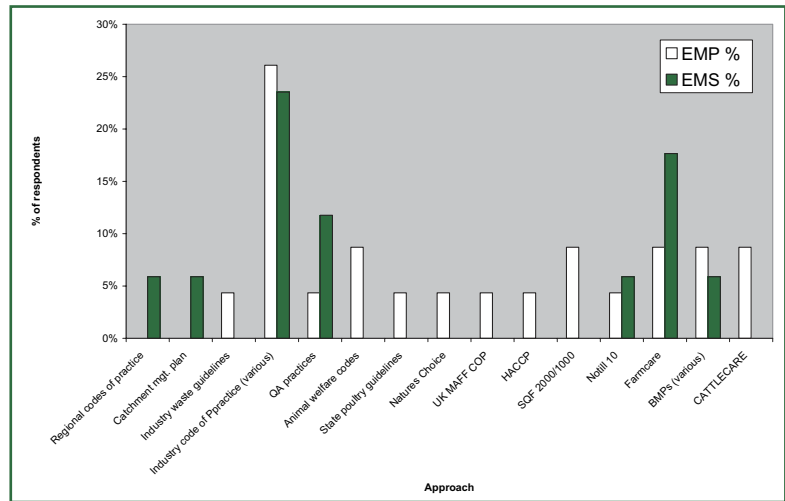


Figure 12 Which if any, any BMPs, COPs or similar used?

Mech (2002) recommended that the use of EMS be downplayed in Australian agriculture, to allow increased development of a wider range of industry BMPs or COPs that provide specific production-related, outcome-focused information for farmers to follow. However, Panayotou (2001) stated that ‘... enforcement of “best practices”, regardless of local conditions is misguided, and could eliminate most of the beneficial features of an EMS (flexibility, gradual progression towards environmental goals and voluntary commitment)’. The results of this study showed that where environmentally-related BMPs were available, farmers using an EMS were more likely to use these in management. It would appear that a combination of EMS and BMPs or similar may produce the best outcomes, but not if they are used in such a way that innovation and adoption are stifled by over-zealous ‘enforcement’ of their adoption. One of the EMP farmers commented that the code of practice developed in his own state for farmers in his specific industry group was too prescriptive and he felt that ‘it gave the grower little control’ and made him feel that he was being ‘dictated to by contract customers’. This farmer rated the usefulness of this code of practice as only 1.5 – very low.

Of the other industry-developed codes, the Farmcare Code of Practice (developed by the Queensland Fruit and Vegetable Growers) was rated moderately highly by farmers in both groups who used it (average of 8.25 for EMP and 7 for EMS farmers). Two of the EMS farmers reported using the Cotton Best Management Practices for pesticides, although neither was a cotton farmer. Their opinions of the usefulness varied (one rated the BMP Manual as 7, the other as 3). One of the EMP farmers had used the National Strategy for Ecologically Sustainable Development (NSED) to guide his overall management approach, rating this document as 7.5 in usefulness. Various other BMPs and COPs ratings varied from 7.5 – 10 for the EMP group and 3 – 10 for the EMS group. Finally, the EMS group more often gave a ranking for the BMPs/COPs used.

An EMS provides a mechanism to implement the features of a BMP that suit the individual situation, and allows for the evaluation of the success of following such recommended practices in a structured and consistent manner. Some farmers in this

study mentioned that they felt overwhelmed with information at times, and discussed the need for a ‘filter’ to allow them to determine the relevance of any particular practices for their own circumstances. The risk assessment utilised in an EMS approach apparently provided such a filter for several farmers in the EMS group. Farmers in both groups were critically examining the outcomes of application of various BMPs, and those in the EMS group sometimes applied BMPs/COPs for either industry sectors or regions other than their own in their farm management.

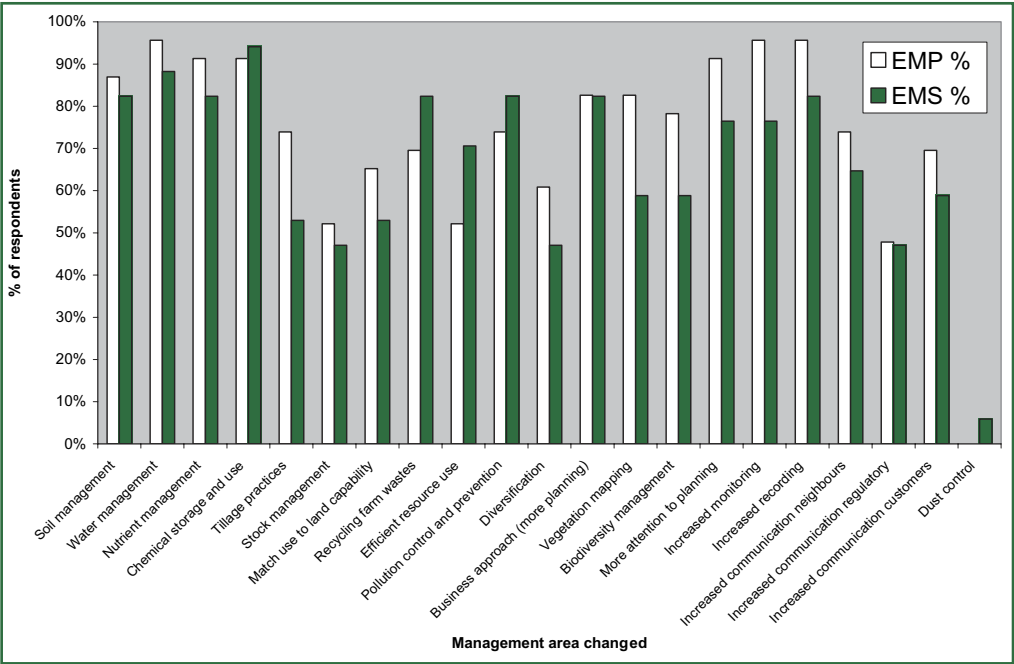


Figure 13 What changed in management?

financial considerations in approximately 15% of both groups. One EMS farmer stated that they had been influenced by income generated compared with cost of meeting performance requirements, but regulatory pressure had not resulted in farmers in either group changing enterprises. Environmental performance was a factor for 18% of EMS farmers, but no EMP farmers nominated this issue.

With a prompt list of categories, farmers were asked to indicate what had changed in their management on-farm. They were also able to add other areas of management change if they wished. Both groups showed similar numbers of respondents making changes in soil, water, and nutrient management, chemical use and storage, stock management, increased business approach/planning and communication with regulators (Figure 13).

Tillage practices, matching land use to capability, diversification, vegetation mapping, biodiversity management, increased attention to planning, monitoring, recording, and increased communication with neighbours and customers were areas more frequently changed by EMP farmers.

3.8 What changed in management?

Farmers interviewed reported that their ranges of enterprises had changed as they embarked on improved environmental management (87% for EMP and 76% for EMS farmers), with the areas of land use or paddock boundaries also frequently changing (78% for EMP and 53% for EMS farmers). Enterprise change and/or management change was stimulated by

The EMS group more frequently reported changes in areas of recycling, efficiency of resource use, and pollution control and prevention (the ‘brown’ environmental issues). Pollution prevention is highlighted in the ISO 14001 Standard and the associated ISO 14004 Guidelines (Standards Australia 1996a and 1996b), and many of these ‘brown’ issues assist in preventing pollution in general.

It is interesting that the EMP group reported more changes in planning, monitoring and recording than EMS farmers. Fear of increased paperwork and reporting are two of the barriers to EMS adoption often suggested. It may be that EMS farmers in this study had already addressed the business-related issues of communication, planning and record-keeping in quality assurance programs, and thus did not change these areas as often as the EMP group. Alternatively, it could be that, because the EMS farmers were already doing more monitoring and recording, they were more likely to be aware of environmental management changes needed; they recognised that they needed to deal more aggressively with environmental issues, and were possibly more likely to utilise EMS as a tool because it encompassed or extended existing management approaches. Whatever the case, several EMS farmers commented that using an EMS process allowed them to rationalise the amount of paperwork they required to effectively operate their businesses. Therefore, the ‘paperwork’ barrier to EMS may be one created more by perception rather than reality. In addition, the EMS group may also have already adopted innovative practices such as improved tillage, land use capability and various means of gaining information (mapping, increased communication and similar practices.) and so did not regard, or specifically identify, these as areas of change.

3.9 Issues addressed in environmental management

Identification of issues

Farmers were asked which environmental issues they were currently addressing in their routine farm management, how they felt these rated in priority (on a ‘1 – low’ to ‘10 – high’ priority scale) and how these issues had been identified. In a few cases, some farmers did not rank issues on a priority basis, but merely indicated that they were issues of concern. For the purposes of calculating average rankings of priority, these cases were assigned an arbitrary ranking of 5. In addition, where farmers had indicated a ranking between two numbers (for example, a priority between 9 and 10), the higher level was taken to be indicative of the priority ranking.

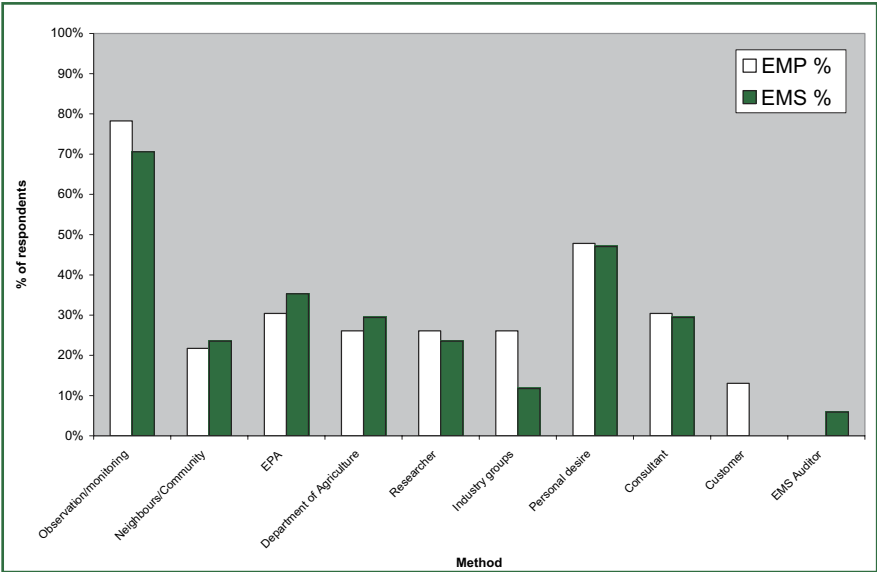


Figure 14 Methods used to identify issues to address

Several farmers also indicated that certain issues had originally been of greater concern, but had been addressed in current farm management, and so were now ranked lower that they might have been previously.

Methods used to identify issues and/or to select those to address as a 'priority' are shown in Figure 14. Both groups used observation and monitoring of on-farm conditions as the predominant means of identifying issues. Personal interest and desire also featured in around 50% of both groups. Environmental protection agencies and state agricultural department staff assisted in identifying issues in around 30% of cases for both groups. Three EMP farmers stated that customers had raised specific issues to deal with and one EMS farmer had issues identified by their EMS auditor during the course of audits.

Three EMP (13%) and four EMS farmers (24%) indicated that certain issues had been addressed solely due to regulatory pressure. In the EMP group, poultry and piggery operators identified local councils and the EPA as key regulatory drivers, with odour, soil, nutrient, and irrigation management as the issues being addressed. The EPA was the sole regulatory driver named by EMS farmers in aquaculture, cotton, feedlot, and mixed farm categories. Here the issues were also industry linked. In aquaculture, the specific areas of concern raised by regulatory pressure were water, soil, and air contamination. Air and odour were key regulatory issues for the feedlot operators. The mixed enterprise farmer cited OH and S, chemical storage and handling, and the cotton farmer cited spray drift and water management. These issues were commonly linked with permitting/reporting requirements and were often detailed in consent documents.

Issues addressed

The breakdown of issues addressed by farm management is shown in Figures 15a to 15i. The mean priority ranks calculated for the whole group are shown in Figures 15a.1 to 15i.1 (i.e. means are calculated for the full 23 EMP and 17 EMS farmers, rather than just for the number of farmers who answered the particular questions). This has been done in order to determine whether there are any differences between the two groups, rather than between individuals, in their attitudes to the importance of the various issues raised. It also means that a single individual dealing with one issue only, and giving it a priority rank of 10, does not skew the mean results.

In almost all cases (except soil erosion), a greater percentage of EMS farmers reported addressing the issues identified than did EMP farmers. EMS farmers also reported addressing a larger number of issues. On average, they covered 32.5 issues per farm within their EMSs, while the EMP group were addressing 5 issues. In part, these differing averages are due to the tendency of EMS farmers to include more waste management and business issues (such as energy efficiency, waste and pollution management and emergency and contingency planning) in their management approaches than EMP farmers. To some extent, this result may have occurred because the EMS farmers were using ISO 14001 to guide their EMS development. This Standard specifically mentions pollution prevention as one of the goals, and raises efficiency

of resource use in the related document, ISO 14004 (Standards Australia 1996b). Business issues such as communication, training, emergency planning, documentation, and annual performance reviews are also addressed with the Standard. Additionally, the use of a risk assessment process as part of an EMS development may also prompt a greater diversity of issues being identified, as the root causes of environmental impacts (termed aspects in the ISO 14001 Standard) also need

to be identified, rather than just the impacts. Therefore, in answering the question, the EMS farmers may have been more discriminating in reporting of the issues covered. For example, instead of simply saying ‘soil’, the EMS group often broke soil management up into a greater number of management issues that did the EMP group.

Water

Both groups nominated water management in general most frequently as an issue. The two groups reported 10 different categories of water management issues in common (see Figure 15a). However, only single EMP farmers addressed five of these ‘water’ categories (storm water, effluent and surface water management, drought-proofing the farm and keeping water on the farm). In the EMS group, the ‘drought-proofing the farm’ category was the least commonly reported (two farmers only). In spite of more EMP farmers nominating salinity as the ‘crisis’ resource condition driving the adoption of changed practices, only two (9%) reported addressing water tables as a specific management issue. In contrast, over a third (36%) of EMS farmers were dealing with water tables routinely.

Water management was the most highly rated issue by both groups (when averages were calculated over the whole group, Figure 15a.1); however, the EMS group rated this issue nearly twice as highly as the EMP group. Water use was the next highest priority issue for the EMP group, followed by irrigation application/management and

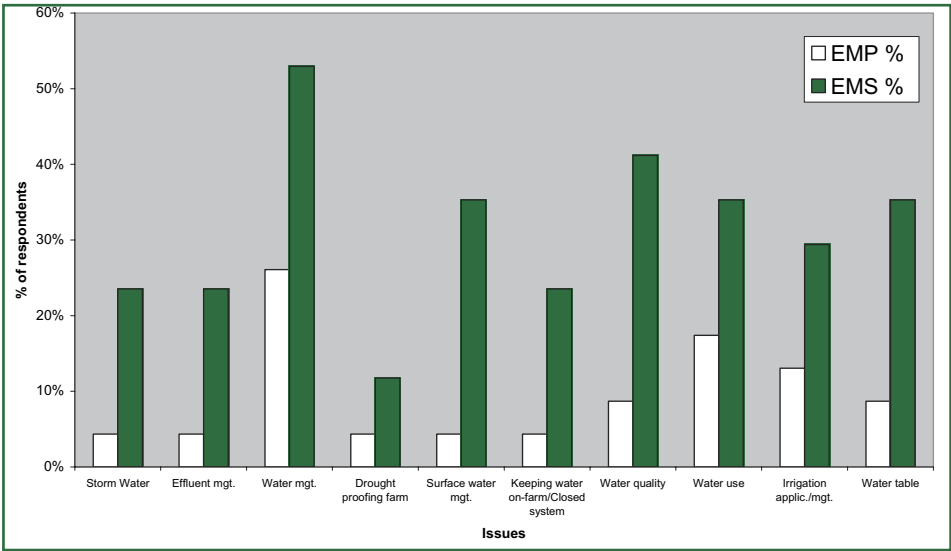


Figure 15 a Water management issues addressed on-farm

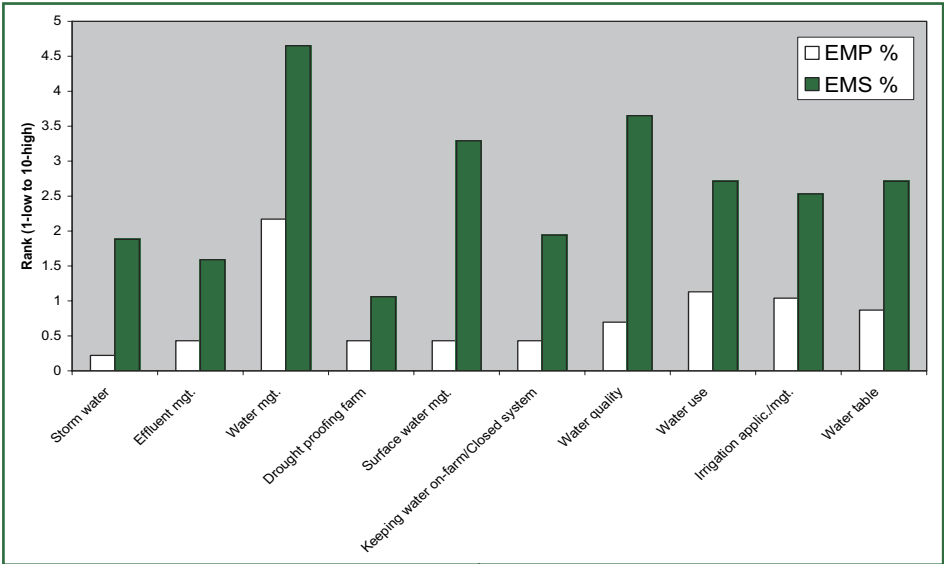


Figure 15a.1 Group mean priority ranks for water management issues

water tables. All of these issues rated 2 or lower as averages. Storm water management was the lowest priority issue for this group, but as this issue is of more concern in certain industries, the low ranking may reflect the representation of these industries in the study.

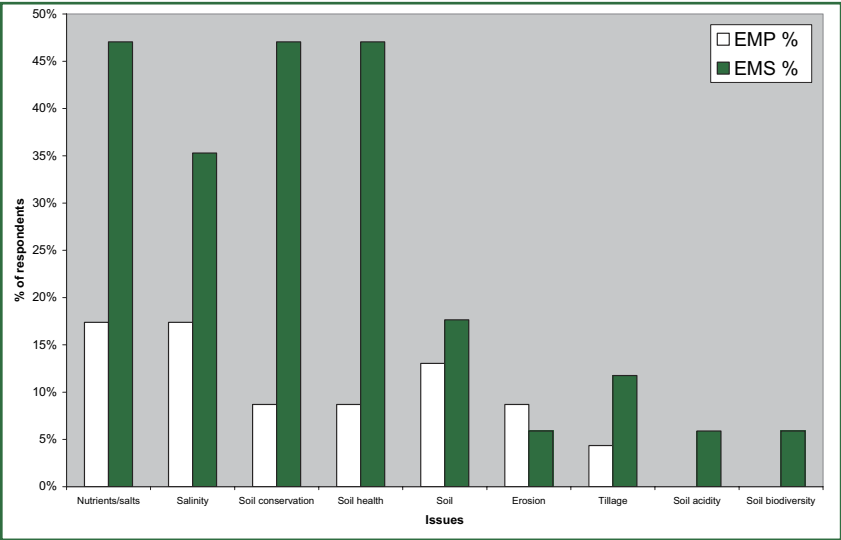


Figure 15b Soil management issues addressed on-farm

For the EMS group, water quality was rated 3.5 on average in importance, followed closely by surface water management, and then water use and water tables ranking approximately 3 in priority. Drought-proofing the farm was the lowest ranking issue for this group, reflecting the fact that very few of the EMS farmers felt this was a priority.

Soil

Soil management issues addressed on-farm are shown in Figure 15.b. Of the 7 categories discussed by the EMP group, salinity and nutrients/salts were each being addressed by 17%. A further 13%

stated they were addressing ‘soil’ as a general issue. Two of the EMP farmers reported addressing soil conservation and soil health with a single farmer addressing tillage.

In the EMS group, nutrients/salts, soil conservation and soil health were each being addressed by 47%. Approximately one-third were addressing salinity; 18% included soil as a general issue, and 12% dealt with tillage. The EMS group also had individual farmers addressing erosion, soil acidity and soil biodiversity.

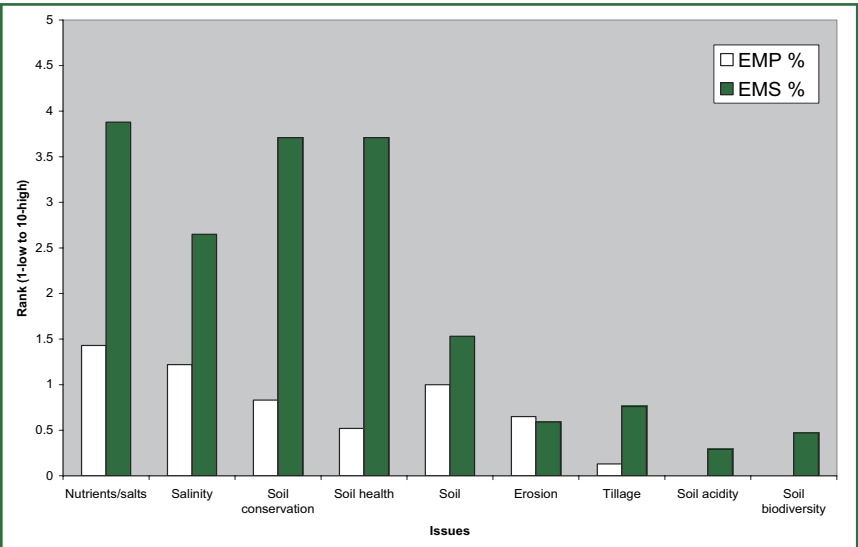


Figure 15 b.1 Group mean priority

Nutrients/salts was the highest priority issue in the EMP group (approximately 1.5), with salinity next (Figure 15b.1). Tillage was seen as the least important issue (0.13).

For the EMS group, nutrients/salts (rank of 3.88), soil conservation and soil health (both ranked at 3.71) were the high priority issues, with salinity next. Soil acidity was the lowest ranking issue (at 0.29).

With the exception of erosion, the EMS group rated all soil issues as higher management priorities than the EMP

group. Priority ranks for erosion were 0.65 in the EMP group and 0.59 in the EMS group.

Biodiversity

Biodiversity issues were reported more frequently by EMS than EMP farmers as management areas (Figure 15.c). The two groups each identified 8 biodiversity management areas in common, with a further issue (escapee fish) specific to an open-water aquaculture venture in the EMS group. Approximately 50% of the EMS group stated they were dealing with biodiversity (as a general term) compared to around 20% of the EMP group.

In the EMP group, 22% covered tree planting in their farm management approaches; 13% reported addressing flora and fauna management, and 9% specified fauna as a separate category. Single farmers were addressing trees, tree decline, remnant vegetation management and weeds.

Of the EMS group, 41% addressed tree planting and weeds, just under one-third addressed remnant vegetation management and flora and fauna management and 20% listed fauna. A single farmer listed tree decline.

When average rankings across the whole group were calculated, biodiversity as a general topic rated as the highest priority issue for both groups (but under 4.5 for both groups). The lowest priority issues were remnant vegetation management for the EMP group and tree decline for the EMS group (the escapee fish issue was specific to only one EMS farmer, so is not considered here). Using group averages, the EMS group ranked all biodiversity issues more highly than the EMP group.

Biodiversity as a general category was the highest priority issue for the EMS group, ranked at 3.88 on average. The EMP group ranked this issue at 1.96. All biodiversity issues were ranked as higher priorities by the EMS group than the EMP group.

One of the concerns that has been expressed by some groups within Australia about the application of EMS, and ISO 14001 in particular, is that farmers will tend to concentrate only on those issues specifically mentioned within the Standard (such as compliance with legislation and pollution prevention) rather than addressing the 'greener' issues such as biodiversity, which is not specifically mentioned. The results of this study do not support that assertion, as the EMS farmers more frequently reported addressing

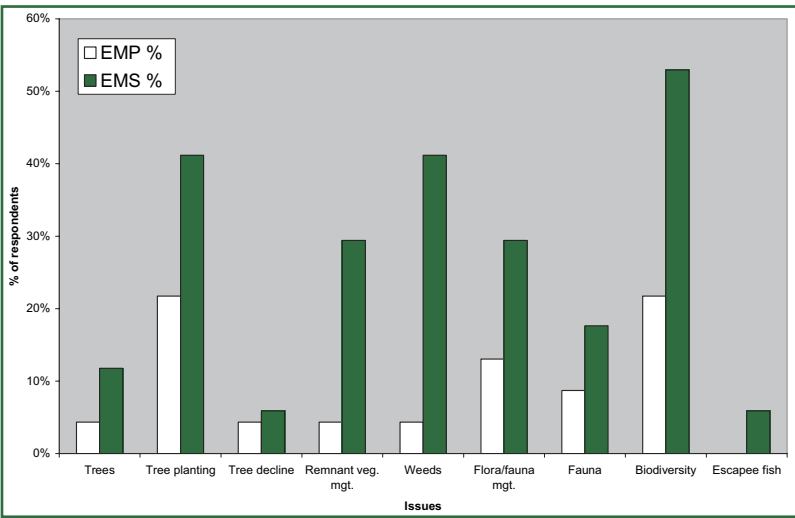


Figure 15c Biodiversity issues addressed on-farm

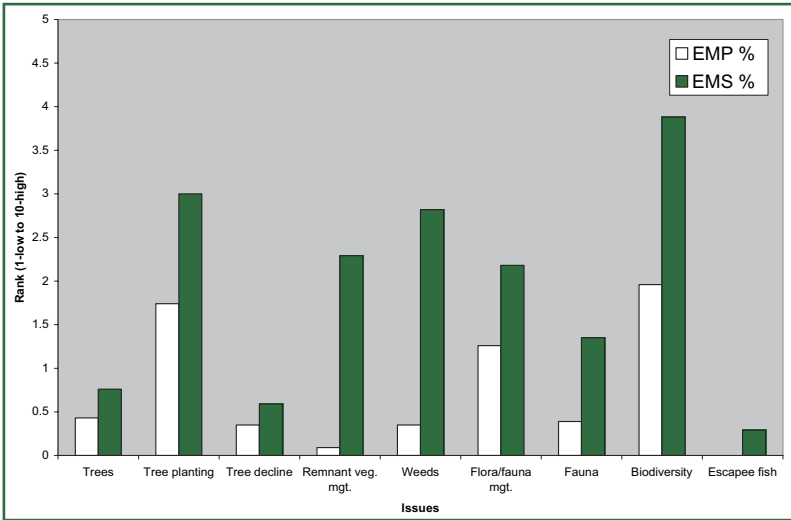


Figure 15c.1 Group mean priority ranks for biodiversity management issues

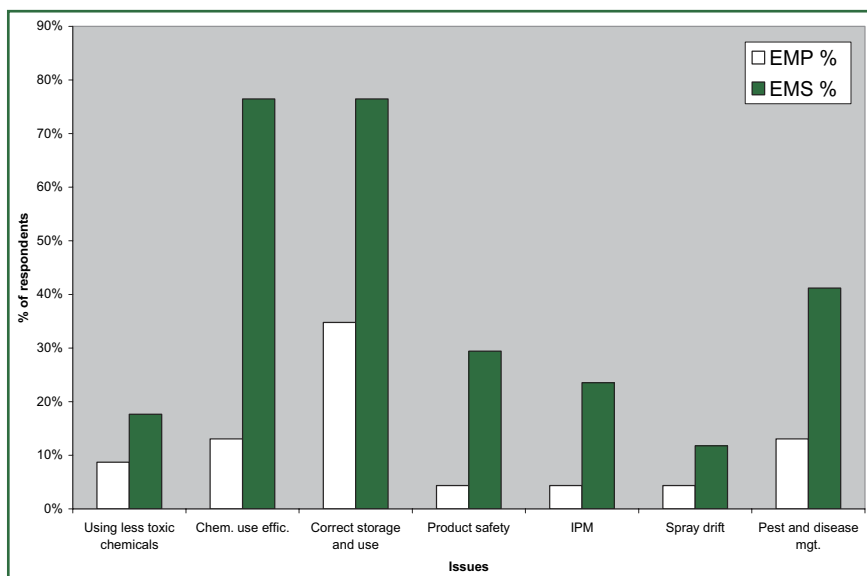


Figure 15d Chemical management issues addressed on-farm

pest management (24% compared with only one EMP farmer). Spray drift was the least commonly nominated issue for either group.

The most highly rated issue in both groups was the correct use and storage of chemicals (Figure 15d.1). The EMS group rated this issue nearly twice as highly as the EMP group. Chemical use efficiency and pest and disease management were the next two priority issues for the EMP group, with using less toxic chemicals the least priority (product safety, IPM and spray drift were all nominated by single farmers only, hence their low overall priority). For the EMS group, the priority ranking order for other issues was

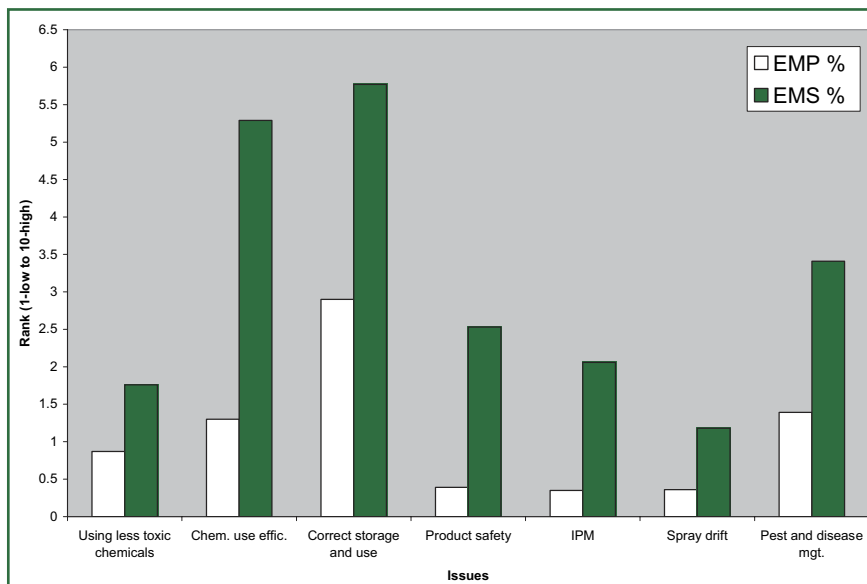


Figure 15d.1 Group mean priority ranks for chemical management issues

biodiversity than EMP farmers. Derrick and Sugden (2001) also have recognised the contribution that EMS can make to biodiversity conservation.

Chemical management

Correct chemical storage and use, and chemical use efficiency were each addressed by 76% of the EMS farmers, with EMP farmers covering these issues in 35% and 13% of cases respectively (Figure 15.d). Pest and disease management was being addressed by 41% of EMS farmers, but by less than 15% of EMP farmers. This may tie in with the higher proportion of EMS farmers reporting the use of integrated

pest and disease management, product safety, IPM, using less toxic chemicals and then spray drift. Legal compliance may have been one reason for the high ranking given to correct storage and use of chemicals for this group, but given the group's recognition of public opinion and pressure as a motivational force in adopting EMS, chemical storage and use may also have been dealt with early on as a way to allay community concerns about these issues. However, this issue was also rated relatively highly by the EMP group, and perhaps it and efficient chemical use are two that agricultural managers are almost universally concerned about.

Pollution

EMS farmers more frequently reported addressing pollution issues than EMP farmers, with this area being covered on less than 15% of EMP farms (see Figure 15.e). For the EMP group, the most commonly nominated pollution issue was on-site contamination and spills (13%). In contrast, 47% of EMS farmers were addressing this in their farm management, and 40% addressed air pollution and environmental contamination. Controlling contamination and external (i.e. off-farm) oils spills were only addressed by the EMS group.

On-site contamination/spills was the most highly rated priority issue by both groups (Figure 15e.1). Environmental contamination and odour were next equally for the EMP group. For the EMS group, environmental contamination was next, followed by air pollution. The lowest ranked issue for the EMP group was noise and for the EMS group, odour.

As the ISO 14001 Standard specifies commitment to the prevention of pollution as one of the elements of the Standard, this attention to pollution management amongst EMS farms is not unexpected. Klassen and Whybark (1999, cited in Andrews et al. 2001) reported that pollution prevention yielded improvements in both manufacturing and environmental performance, whereas pollution control was more likely to result in moving pollutants into a different medium or location, which added costs and worsened manufacturing performance. For farmers, addressing the source of pollution is far more cost-effective than dealing with disposal of pollutants after they arrive on the farm. The benefits that can accrue from EMS use in this area are yet to be ascertained.

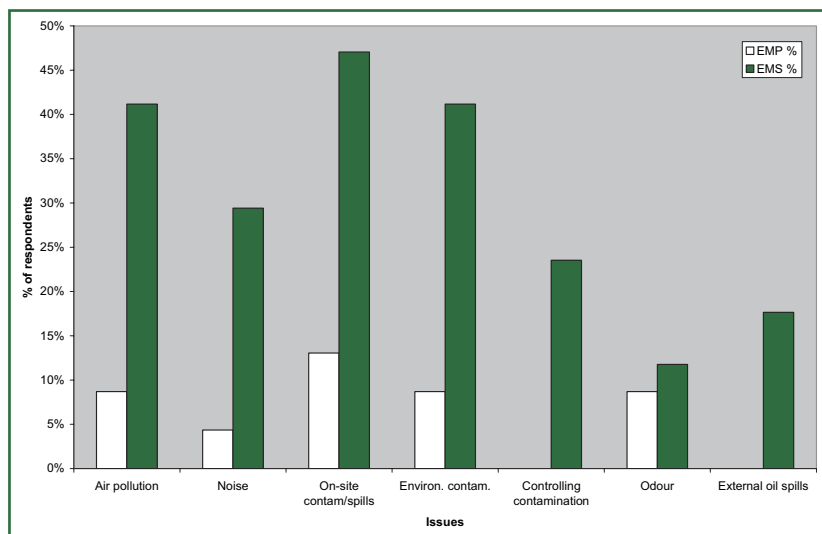


Figure 15e Pollution management issues addressed on-farm

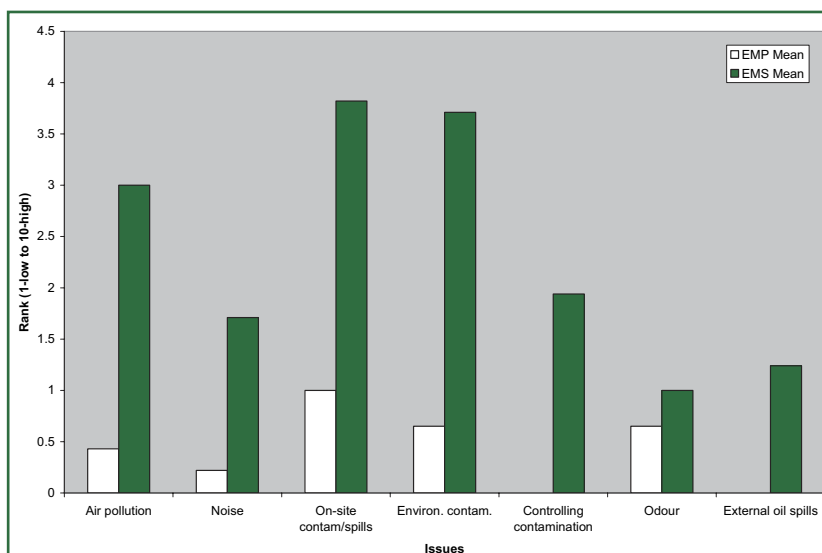


Figure 15e.1 Group mean priority ranks for pollution management issues

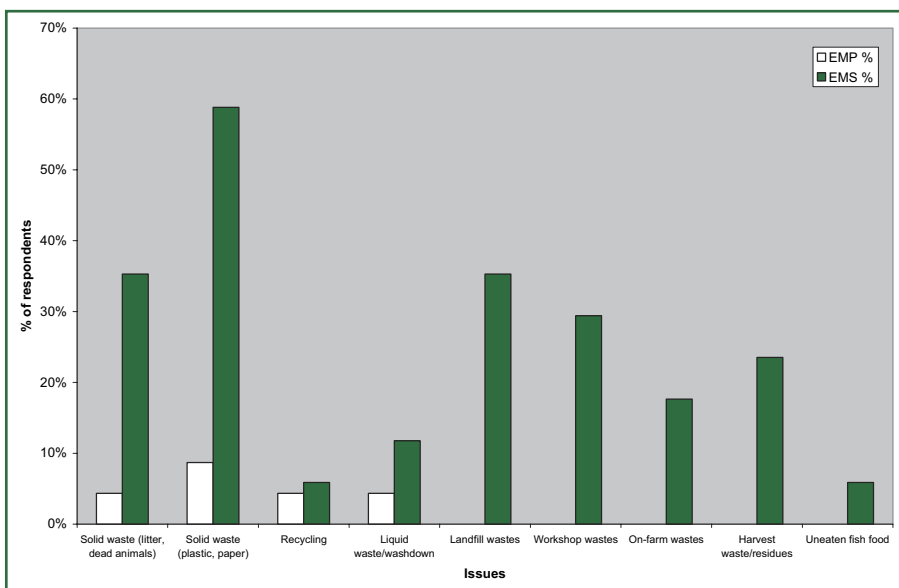


Figure 15f Waste management issues addressed on-farm

Waste management

EMS farmers reported twice the number of waste management issues compared with EMP farmers (see Figure 15.f). In addition, the EMS group also included one specific area of waste management linked to an aquaculture enterprise. The management of solid wastes (five categories were reported) was the predominant area of concern, and may be linked to the low reporting of recycling being covered as an issue. Farmers in both groups frequently reported inability to access suitable recycling facilities near their farms, preventing greater use of recycling as a waste management method.

Solid waste management was the most highly rated issue for both groups but, again, the EMS group rated this issue more highly than the EMP group. Waste management and

disposal were the next highest rating issues for the EMS group. Recycling was the lowest ranking issue for both groups, perhaps reflecting the difficulty many farmers raised in accessing recycling services in country areas (Figure 15f.1).

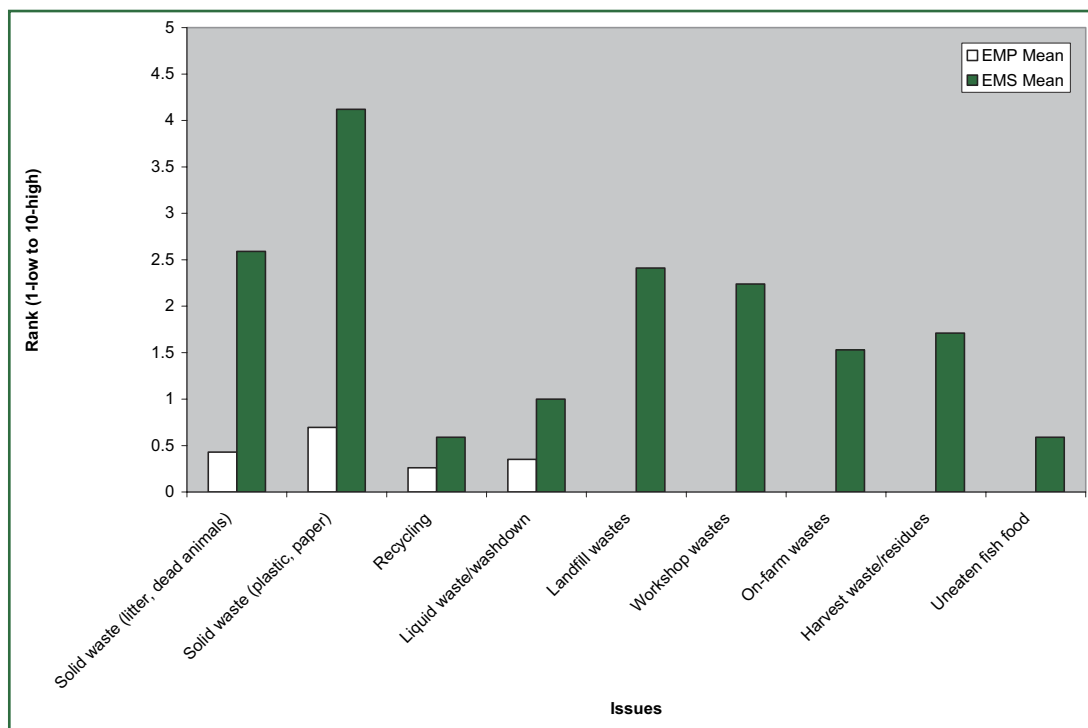


Figure 15f.1 Group mean priority ranks for waste management issues

Greenhouse gas emissions

Less than 20% of farmers reported addressing greenhouse issues. Greenhouse gas emissions and carbon sequestration were addressed by three EMS farmers and a single EMP farmer (Figure 15.g). These issues are likely to be industry-linked to some extent, and possibly would have featured more commonly if intensive livestock enterprises had formed a greater proportion of the case studies.

The EMS group rated these issues more highly on average (Figure 15g.1), but the rankings were relatively low when compared with the range of other issues raised by the farmers in both groups. The low priority given to greenhouse issues may be due to the tenuous link with production-related matters or to the lack of solutions easily applicable on-farm.

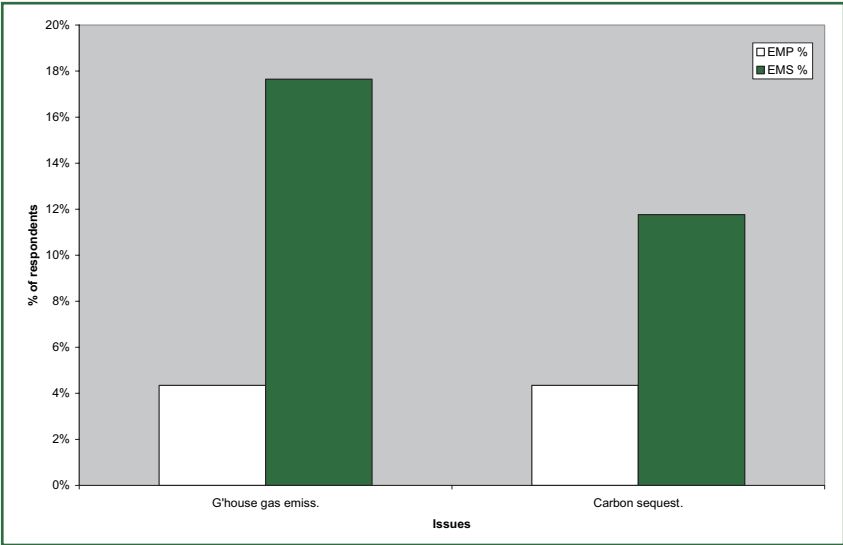


Figure 15g Greenhouse gas emission issues addressed on-farm

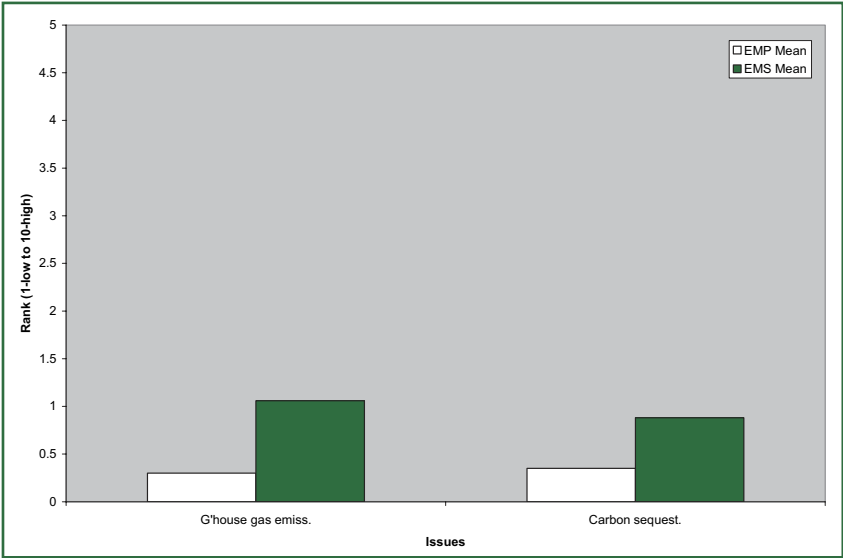


Figure 15g.1 Group mean priority ranks for greenhouse gas emission management issues

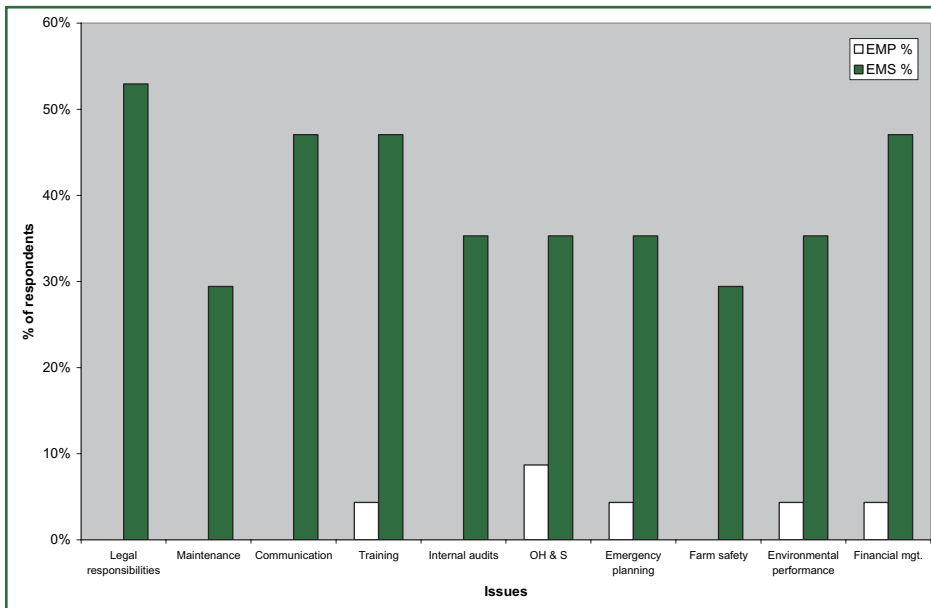


Figure 15h Business management issues addressed on-farm

In the EMS group, legal responsibilities were reported as being an issue covered in farm management in over 50% of cases and were rated as the highest priority business issue (Figure 15h.1). Corbett and Russo (2001) highlighted the effectiveness of the ISO 14001 Standard in raising the profile of legal compliance achievement within a business, when they compared Taiwanese and United States companies. The largest gains in environmental benefits occurred in Taiwanese firms implementing an EMS. These authors attributed this to the fact that through application of an EMS process, the

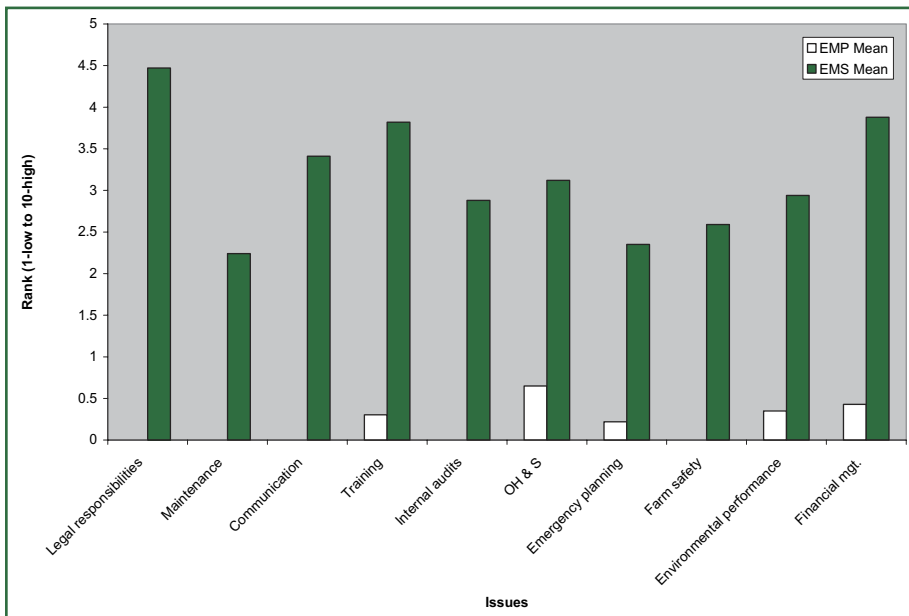


Figure 15h.1 Group mean priority ranks for business management issues

Business management

Twice as many business management issues were reported by the EMS group than by the EMP group (Figure 15.h), with 30% to 55% of EMS farmers addressing these issues. Issues common to both groups were training, occupational health and safety, emergency planning, environmental performance and financial management. Only two EMP farmers reported that they addressed OH and S as part of their business management, with single EMP farmers reporting the other common issues.

Taiwanese firms were required to assess compliance, possibly for the first time. A similar situation may apply in agriculture, where legal compliance has not traditionally been high on the agenda for many managers. Many farmers report that they are unaware of specific legal requirements for the operation of their farms, and fear of increased levels of regulation is often raised as an issue by farmers. Using an EMS may serve to raise the profile of such issues within the overall management on farms, and perhaps, for this reason alone, should be encouraged amongst Australian farmers, in order for them to protect their business interests.

Communication, training, and financial management were all reported as being addressed by just under 50% of all EMS farmers. The first two issues are specifically addressed within the EMS standard, and so may have come to prominence because of the requirement to take specific actions on these issues. Financial management is also important within the planning phase of an EMS, and is usually taken into account when determining the priority of environmental issues to address. Again, the EMS farmers answering this question did so from a different perspective to the EMP farmers and may therefore have ‘split’ issues rather than lumping them together.

Other issues

Finally, more EMS farmers reported addressing what was termed ‘general’ management issues than did EMP farmers (Figure 15.i). “Housekeeping” was a term used by the farmers to describe the overall tidiness of the farm, and often related to the clean up of old farm dump sites and similar. Two farmers in the EMP group each reported addressing farm management and energy use, with single farmers addressing resource management and “housekeeping”. Approximately one-third of the EMS farmers were dealing with farm management, a similar number were addressing resource management and “housekeeping”, and around 40% nominated energy use as an issue.

Farm management was the highest ranked issue amongst the EMP group, with resource management the lowest. However, the EMS group gave resource management an equal priority with energy use, and farm management the lowest. Again, the EMS group average rankings were higher than those of the EMP group (Figure 15i.1).

The EMS farmers were more likely to split issues, rather than lumping them together (based in part on use of a risk assessment approach), and this is possibly why the group reported the wider range of issues as being addressed. Using the ISO

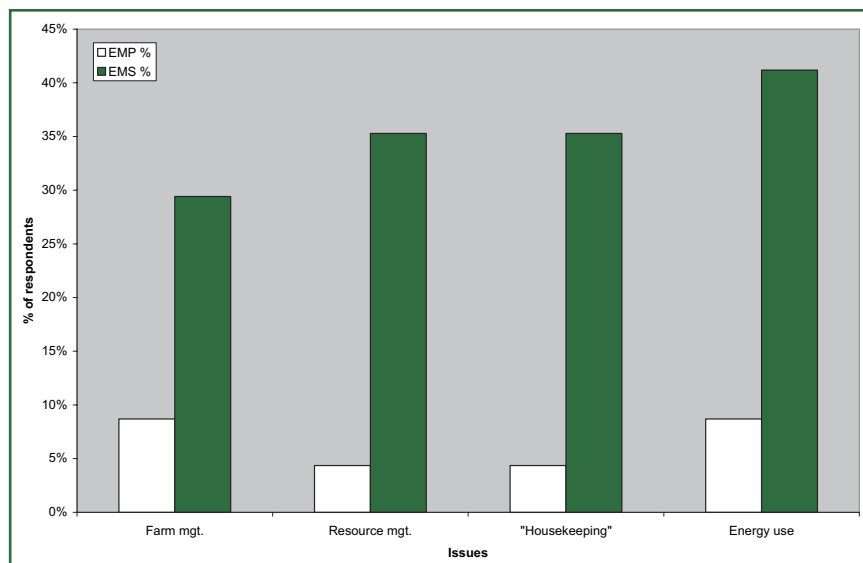


Figure 15i Other issues addressed on-farm

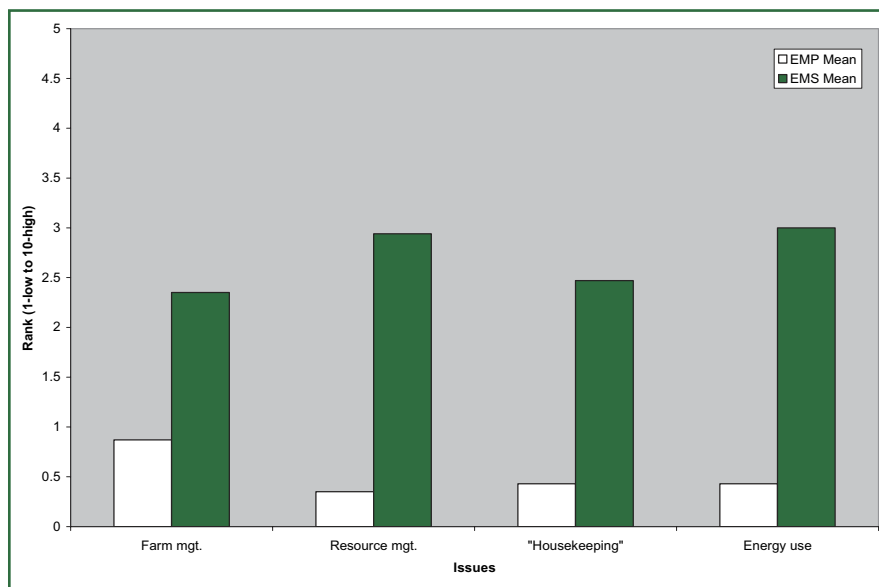


Figure 15i.1 Group mean priority ranks for other management issues

14001 process promotes not only risk assessment, but also a degree of specificity when deciding how to address environmental impacts. This may promote a higher level of specificity in actions taken and thus in issues identified. Both environmental impacts and their root causes (referred to as 'aspects' in ISO 14001) are addressed. This process may stimulate more discrimination in determining issues to address.

It is also possible that EMS users were prompted to identify a greater range of issues by the EMS advisors/consultants they worked with. Setting specific goals can serve as a motivator to progress towards those goals (Metzenbaum 2001), so identification of both environmental impacts and aspects is potentially more likely to result in targeted and specific action to address the issues. For farmers, setting out their goals in a written document (or a policy statement, as is required by ISO 14001) is likely to reinforce the initial motivation to take action.

Overall, it is clear that the EMS group was dealing with a much wider range of issues, and that they tended to rate almost all issues more highly than the EMP group.

In order of priority, the top issues (with their group average priority ranks shown in brackets) nominated by the EMP group were:

1. chemical management – correct storage and use (2.9)
2. biodiversity management – biodiversity (1.96)
3. biodiversity management – tree planting (1.74)
4. soil management – nutrients and salts (1.43)
5. chemical management – pest and disease (1.39)
6. chemical management – chemical use efficiency (1.3)
7. biodiversity management – flora and fauna (1.26)
8. soil management – salinity (1.22)
9. water management – water use (1.13)
10. general management – farm (0.87).

For the EMS group, the top issues (with their group average priority ranks shown in brackets) were:

1. chemical management – correct storage and use (5.77)
2. chemical management – chemical use efficiency (5.29)
3. business management – legal responsibilities (4.47)
4. business management – financial; soil – nutrients and salts; biodiversity – biodiversity (all 3.88)
5. waste management – on-site contamination (3.82)
6. waste management – environmental contamination; soil management – soil conservation, soil health (all 3.71)
7. water management – water quality (3.65)
8. chemical management – pests and diseases (3.41)
9. general management –resources (2.94)
10. biodiversity management – weeds (2.82).

Thus, between the two groups there appears to be a difference in priorities, with a

greater focus on legal issues and compliance evident amongst the EMS group. The EMS group also rated all their issues at a greater priority ranking than the EMP group, except for 'biodiversity management – weeds (2.82) which was only just under the EMP's highest ranked priority of 2.9 for 'chemical management – correct use and storage'.

3.10 Where did farmers get the information required to make changes?

Williams et al. (2000) investigated light industrial SMEs to determine what environmental management services they required and how these should be delivered. This study also attempted to determine such data. Farmers were asked where they had sourced information used to make changes to their farm management, and to rank their satisfaction with the information received from 1 (low – dissatisfied) to 10 (high – very satisfied). They were also asked who they felt should be providing such information and how it should be provided. Use of industry codes of practice and similar approaches, and services provided by consultants have been addressed above.

Where was information sought?

The EMP and EMS farmers utilised a similar range of sources to gain information about environmental and production issues (Figure 16) in order to make changes on-farm.

Industry groups were the most commonly consulted (approximately 90% of both groups), with departments of agriculture, consultants and researchers also forming major sources of information similarly for both groups.

EMP farmers more frequently reported using advice from other farmers and from departments of natural resources staff than EMS farmers. Only two farmers (both in the EMP group) reported using the National Parks Service for information.

The EMS farmers more often reported using environmental protection agencies, Greening Australia, Landcare, industry/commodity groups, and neighbours for information than EMP farmers.

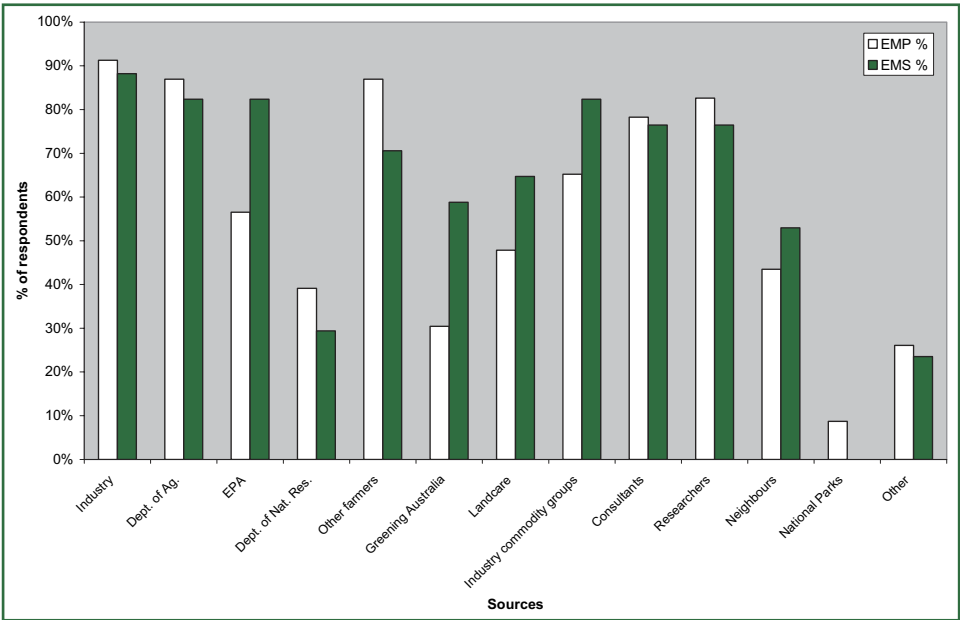


Figure 16 Sources of information about changes

Approximately 25% of farmers in each group reported using other sources of information. The ‘others’ category for EMP farmers included SimPlot, Soil Conservation Services (New Zealand), the Land Management Society and conservation groups (labelled ‘greenies’ by the particular farmer); for the EMS group it included buyers/agents, agri-product retailers, the Internet, and QA auditors.

There may have been a difference in the sort of information being sought by the two groups, with EMS farmers often stating that they had had difficulty sourcing information specifically about EMS. This may account for the EMS groups greater use of ‘environmental information’ service providers such as Landcare, Greening Australia, and EPAs, where information other than that on production could be found. However, it does not explain why the EMS group made more use of information from industry commodity groups (although this may have been linked to the need for market intelligence regarding ‘green marketing’).

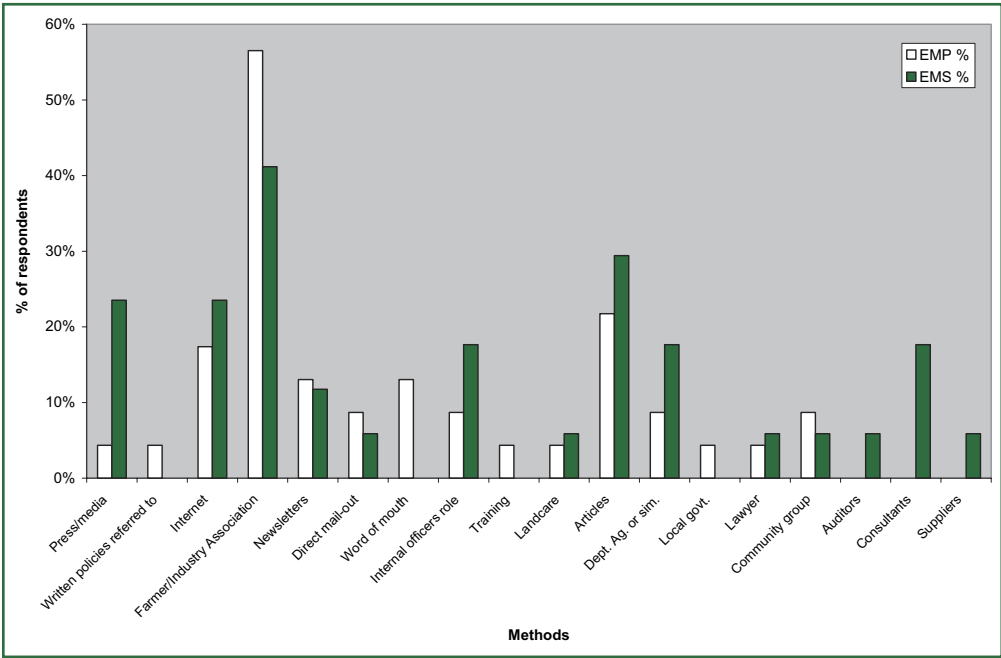


Figure 17 Methods used to keep up to date with legislation

Legal information sources

In terms of gaining information about and keeping up to date with legislation, both groups nominated a range of sources (Figure 17). However, of the 11 categories nominated commonly by the two groups, only six were used by more than single farmers in either group. For both groups, the greatest reliance was on farmer or industry associations, with the EMP group using this information source more than the EMS group.

Approximately one-third of farmers in the EMS group, but around only one-fifth of the farmers in the EMP group, relied on written articles for legal information. Around 20% of both groups also used the Internet. Three categories were nominated by individual EMP farmers, with two categories nominated by individual EMS farmers. In addition, single farmers in both groups stated that Landcare and lawyers provided legal information. Finally, community groups were cited as supplying legal information in three cases.

The EMP group rated information received from industry associations, departments of agriculture, natural resource departments, and other farmers more highly than the

EMS farmers (Figure 18). The highest satisfaction ranking was for information received from departments of agriculture, with the lowest satisfaction from Greening Australia. As only two farmers in this group had sought information from the National Parks service, the satisfaction ranking for this category is low.

Similar levels of satisfaction with information received were noted between the two groups for industry commodity groups, neighbours, and 'other' information providers.

The EMS group rated information received from EPAs, Greening Australia, Landcare, consultants, and researchers more highly than the EMP group. Again, as the EMS group tended to answer this question with specific regard to information sought about EMS, the higher levels of satisfaction with information from EPAs and consultants may reflect the ability of these two providers to deliver the particular type of information required. Industry-focused bodies were less commonly able to provide information regarding specific technical input for solving environmental problems. The EMS group rated information received from consultants and researchers as the most satisfactory, with that from natural resource departments as the least satisfactory.

Lack of information and lack of coordination between information sources was remarked upon by both groups, and was a considerable source of frustration for the EMS farmers in particular. The EMS group frequently suggested the need for a 'one-stop shop' for EMS information, particularly if this could be achieved independently of the provision of EMS services (i.e. not from an EMS consultant). While the EMS group reported a high level of satisfaction with information received from consultants, farmers in the group also expressed a desire for a way to validate information received from consultants from a third party (it was frequently suggested that this be a state government role). The provision of a full-time dedicated EMS officer by NSW Agriculture was highly regarded by this group, with farmers from other states clearly wanting similar services provided.

Another area commented upon by both groups of farmers was the poor articulation of catchment management goals against which they could plan their own farm operations. Where catchment goals had been developed, many farmers felt that on-farm areas of action had not been clearly described (or even developed) and so saw few areas in which they could contribute to catchment health and management. Some farmers suggested that the catchment management blueprints and/or Land and Water Management Plans currently under development in many states might meet farmers' needs for such information, but others were sceptical.

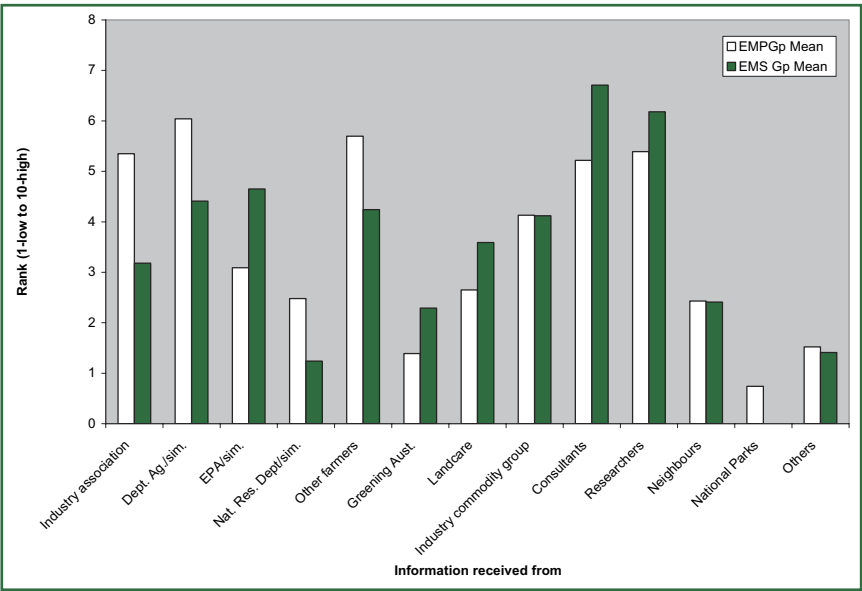


Figure 18 Group mean satisfaction ranks for information received

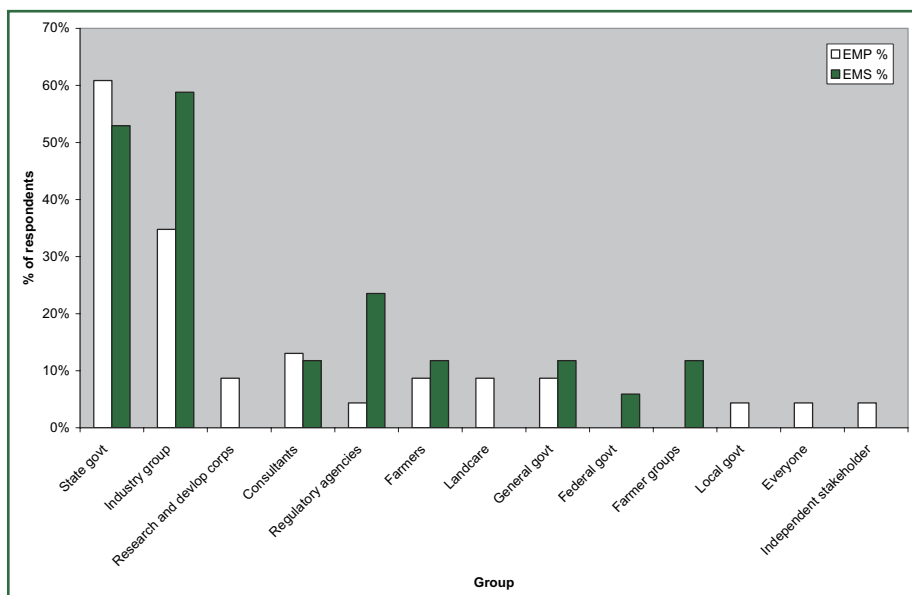


Figure 19 Who should provide information about sustainable practices?

four of these were mentioned by a single farmer only. Only one farmer (in the EMS group) thought that the federal government should serve as an information source for sustainable practices.

Who should provide information on sustainable practices, and how should such information be provided?

Both groups saw state governments and industry groups having a major role in providing information about choices regarding sustainable practices (Figure 19). More farmers in the EMS group than in the EMP group also thought that regulatory agencies should be providing such information. Overall, the EMP group nominated a larger range of information providers, but

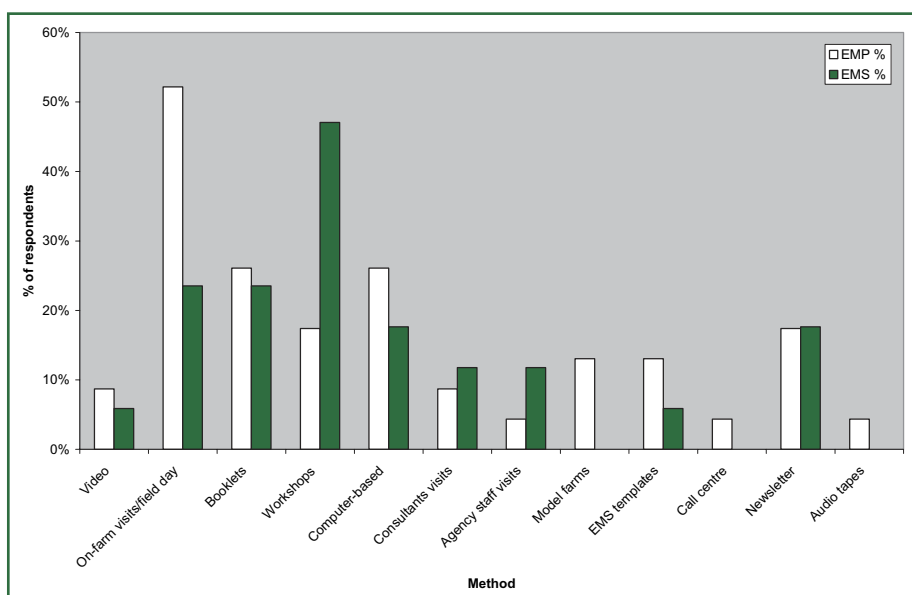


Figure 20 How should information be provided?

The preferred method of gaining information by the EMP group was farm visits or field days, with the EMS group more often suggesting workshops (Figure 20). Provision of booklets (such as case studies), computer-based proforma data, and newsletters were also suggested. One of the farmers in the EMS group commented that he wished he were doing his EMS development after the completion of the current study, so that he could learn from what others had done. Interestingly, the EMP group were more likely to want EMS templates than the EMS group. This may be because the EMS group had

already developed their own material, and so saw little need for assistance in this form.

However, to some extent, the two groups were seeking different sorts of information and most likely answered this question from different contexts. The EMP group may have been looking for more technically based information on addressing specific environmental or production issues, whereas the EMS group was seeking information

specifically to do with EMS development and implementation. These two sorts of information are most likely best presented in different ways. Technical solutions may be best demonstrated by site visits to examine equipment, infrastructure or other solutions in situ (hence the desire for farm visits amongst the EMP group) whereas information about management systems may possibly be best presented in a discussion-based approach, such as the workshops preferred by the EMS group. Friedman and Miles (2001) reported a similar finding, where some of the SMEs involved in adopting environmental initiatives described gaining great value from participating in workshops, rather than simply using printed information, due to the 'networking' potential and the ability to more fully discuss options and potential solutions.

Personal, one-on-one interaction (with consultants or agency staff visits) was also more often suggested as desirable by the EMS group. Again, this may be due to the type of information being sought.

Finally, comments from the EMS group indicated that regulatory agencies had a role (generally unrealised) in 'translating' compliance requirements into practical actions that could be taken on-farm. While this group had a heightened awareness of their legal compliance obligations, many of the farmers expressed their frustration at the difficulty in interpreting such obligations into workable outcomes on-farm.

3.11 Outside parties involved in planning changes on-farm

Farmers were asked about outside parties involved in planning changes to on-farm management (as opposed to sources who provided information). Steger (2000) stated that small to medium enterprises (SMEs) more commonly used outside sources of assistance when developing and implementing EMSs than larger entities. This may be due to the need to gain information/technical support from outside the business – a situation that may not occur in larger enterprises, where existing staff may meet this need. Farmers are likely to require a range of outside assistance when developing an EMS. For production matters, such assistance is available through a range of agencies and institutions, but this is not the case for EMS information and support. Thus, it might be expected that farmers would consult with outside parties when planning changes on-farm, particularly on issues of environmental rather than production-related matters.

The current study investigated which, if any, outside agencies had a role in assisting farmers to develop farm plans. In part, this was done to determine if there were any deficiencies in the availability of assistance to farmers when they attempted to develop enhanced on-farm environmental management. Outside parties involved in planning are shown in Figure 21.

In the EMP group, 20% or less of the farmers had involved outside parties in planning on-farm changes. The most commonly used groups were EPAs, consultants, department of agriculture staff (all 17%), Land and Water Conservation agency staff, industry

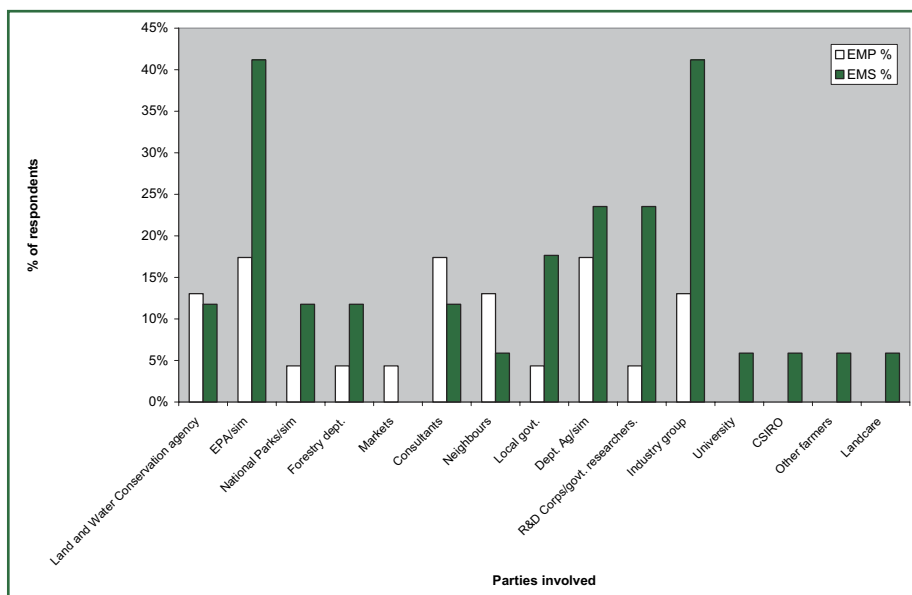


Figure 21 Outside parties involved in planning changes

groups and neighbours (all 13%). The remaining five categories were reported by single farmers only.

For the EMS group, five major sectors were involved – EPAs, industry groups (both 41%), department of agriculture staff, R & D. corporation/researchers (24%), and local government staff (18%). The relatively high involvement of EPA officers assisting EMS farmers in planning changes is not unexpected, as regulatory pressures were more frequently cited by this group as both drivers for change and for determining which issues to address. This group reported using a

wider range of parties in planning than the EMP group, but 5 categories were reported by two farmers only.

Edwards et al. (2002) reported that 85% of enterprises included in their study had involved outside parties in the design of their EMS. Florida and Davison (2001) reported that the EMS group they studied involved more input from local government, and the EMS/pollution prevention group involved more neighbour/community groups, environmental groups, and local businesses. Andrews et al. (2001) reported that approximately 50% of businesses with an EMS had involved local government in environmental management decisions. In the current study, somewhat more EMS farmers had involved local government in planning changes than EMP farmers, although numbers were low here (1 EMP and 3 EMS farmers only). Given the higher number of dairies and intensive livestock enterprises in the EMP group, this result is somewhat surprising. Typically, in Australia, local governments have a large role in granting approvals for such enterprises, and their involvement might have been reasonably expected to be greater in the EMP group.

The current study shows that the EMS group did tend to involve more outside parties than the EMP group in planning changes to be made on-farm, often working with regulatory agency staff. Such involvement could have arisen from the generally low knowledge of EMS amongst farming groups at the time of the study – outside parties may well have been the only option for support available. The slightly higher reliance by the EMP group on neighbours may have been due to the tendency of farmers to support each other when trialling new production methods – the ‘over the fence’ observations and network.

Several farmers mentioned that the changes they had made and the increased communication with agency staff had resulted in better working relationships and

streamlined handling of disputes with neighbours. When asked whether liaison between themselves and regulatory agencies had assisted in resolving conflicts (usually arising from noise, odour, spray drift or similar complaints), 53% of the EMS farmers and 35% of the EMP farmers stated that liaison was effective. A further EMP farmer stated that effectiveness had depended on the issue involved. The higher reporting of effectiveness by EMS farmers may be due to the closer working relationship and consultation with this agency arising from planning on-farm change. Florida and Davison (2001) noted that a higher proportion of the EMS/pollution prevention enterprises they studied reported supportive community relationships (80 – 90%) compared with the non-EMS users (60 – 66%). Such cooperation and communication may be important in achieving improved environmental outcomes, as they could create peer support, which serves as reinforcement for continued efforts.

3.12 Communication about changes

Farmers were also asked who they had communicated with about the changes they had made to their farm management, and the methods they had used to communicate. Establishment of communication networks for gaining information (specifically regulatory/legal information) has been suggested as a barrier to EMS adoption for farmers (Mech 2002). However, for many small to micro-businesses, this area of systems development is in reality streamlined by virtue of fewer staff members, and thus fewer links in communication chains, both within and outside the business.

It is also important that the outcomes of environmental management are communicated to ‘people who can and will do something about it’ (Metzenbaum 2001). In the case of farm environmental management, sharing the outcomes of on-farm management both within and outside the farm business is likely to generate support for active management from any farm staff, farm partners and agency staff. The coalition that developed the Ontario ‘Farm Environmental Agenda’, a forerunner to the Ontario Environmental Farm Plan, was able to generate considerable support for their overall aims once they began proactively offering timely and accurate data on environmental management and outcomes on-farm (J. Wilson, AgCare, Ontario, pers. comm. 1998). Provision of information was also vital in countering misinformation regarding agricultural practices (Wilson 1999).

Farmers in both groups were involved in communicating the changes that they had made on their farms to others. Both groups had used field days and farm tours extensively, and found this means of communication most effective (Figures 22 and 23). One farmer in the EMS group stated that he felt it was ‘better to get an eyeful, rather than an earful’ when gathering information about ways to change his practices. He felt that field days were a good way to promote friendly competition between farmers to extend the outcomes of their management approaches. However, several of the EMS farmers discussed the difficulty that can occur in getting the idea of EMS across through a field day format, emphasising that farmers probably need quite a lot of discussion and thinking time to grasp the concept initially. In addition, it is difficult to demonstrate a system – an EMS is more than the sum of its component parts, and simply looking over documentation, for example, does not fully convey the usefulness of a systems approach.

Groups informed about changes on-farm were industry/agency groups, customers/clients, and banks (for one EMS farmer only). For the EMP group, industry and agency groups were most frequently cited as communication partners (approximately 60% of cases), with communication most commonly occurring through field days. Amongst the EMS group, reports to industry and agencies, articles and conference papers were used to communicate in approximately 45% of cases, with field days and tours again being the major form of communication (approximately 60%). The EMS group also reported direct communication to clients in around 40% of cases, substantially more than reported by the EMP group. More communication by the EMP group to industry or agencies may have been linked to the greater provision of funding for on-farm works, with communication being a part of fulfilling funding body requirements. As the EMS group less commonly received funds to assist with EMS implementation, they may have had fewer reporting requirements to funding bodies.

Florida and Davison (2001) reported that secondary industrial businesses with an EMS or pollution prevention program were more likely to report sharing information with government agencies, business customers, neighbours and environmental groups –this often occurs through community outreach programs. However, this may be linked to the nature of the businesses they studied, as they were more likely to come under a suite of regulatory reporting requirements than farms. In the current study, the EMS group reported more communication with clients and customers but not agency staff. The EMS group had indicated that part of their motivation to change had resulted from market pressures, and so their higher degree of communication to clients is not surprising.

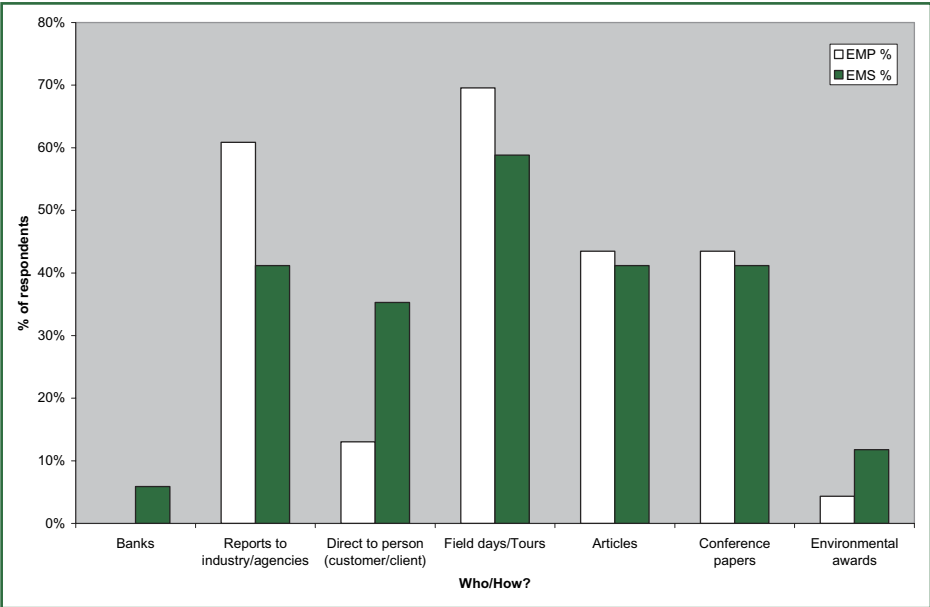


Figure 22 Communication about changes made – to whom and how?

the changes they had made, and so these farmers had not been willing to expose their farming operations to increased scrutiny as a result of publicity.

Both groups reported similar rates of communication through conferences and articles (Figure 22), although neither rated these forms of communication as particularly effective (Figure 23). Field days and visits were seen by both groups as the best way to highlight changes made on-farm. In addition, some of the EMS farmers indicated that they had not made any particular efforts to tell others what they had done, as they were ‘not yet ready’ to do so, or in some cases, were apprehensive of peer reaction. At least three EMS farmers stated that their peers felt threatened by

3.13 Support and involvement with changes

Metzenbaum (2001) claimed that sharing goals could enlist support to achieve them. The parties involved in communication about changes described above might also then be involved in providing support for farmers to adopt changed practices. The levels of support received and the involvement of a range of parties with changes to management on-farm were investigated within the current study.

Farmers were asked to rank both support and involvement on a 1 (not very supportive/involved) to 10 (very supportive/involved) scale for a range of nominated groups. Farmers could also name other groups that had either supported them or had been involved in making changes on-farm. The groups supporting and involved are shown in Figures 24 and 26 respectively, with group mean ranks for supporters and those involved shown in Figures 25 and 27.

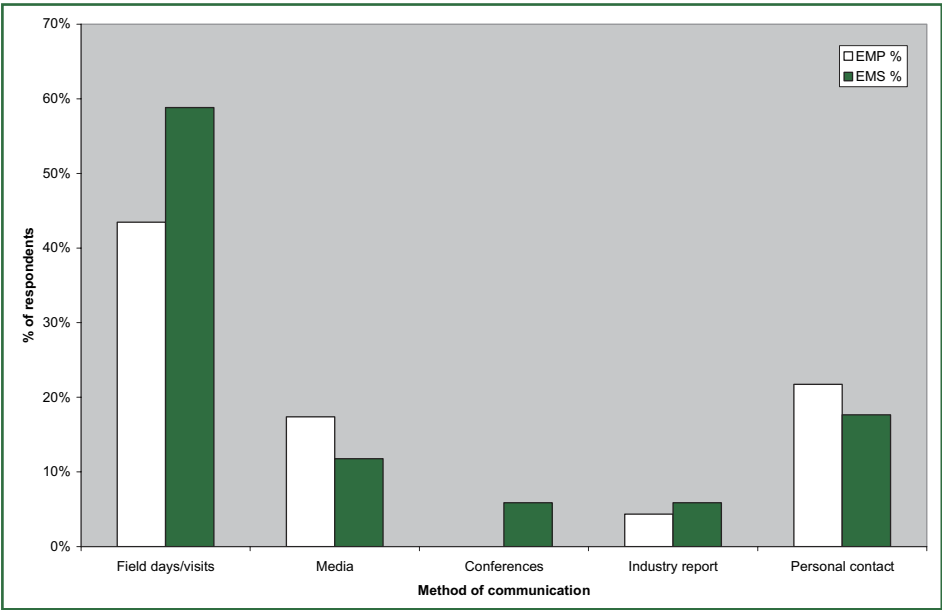


Figure 23 What form of communication has worked best?

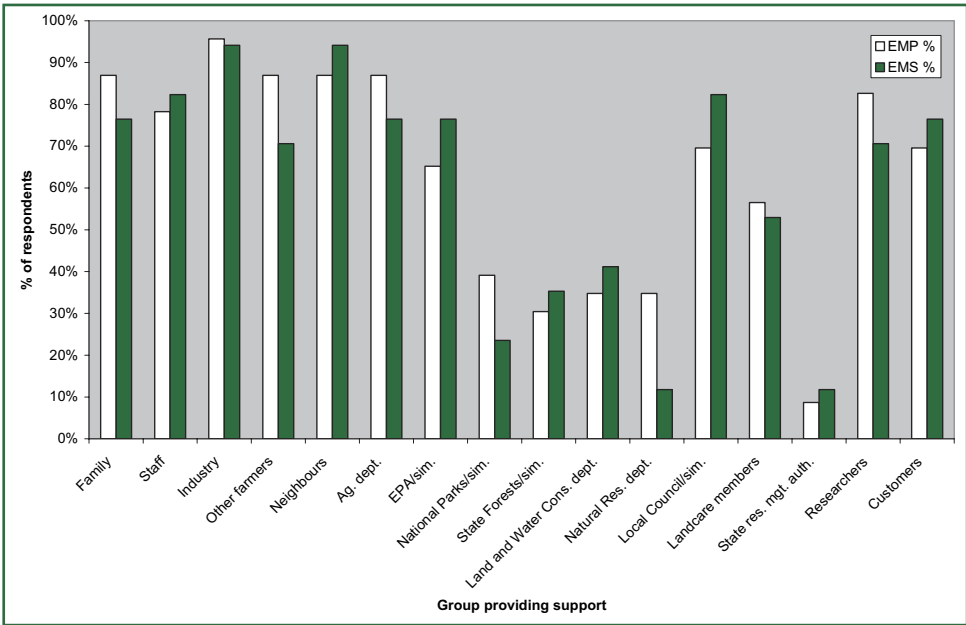


Figure 24 Support received when making changes to management

Support when making changes

The EMP farmers most frequently cited industry groups (96%) for providing support when making changes on-farm (Figure 24). Eight other groups were also mentioned in over 70% of cases. For the EMS farmers, industry groups and neighbours were the two most frequently nominated sources of support, with seven other groups nominated in over 70% of cases. State resources management authorities were the least frequently nominated support providers by both groups (less than 10% in both cases). The National Parks Service, State Forests, Department of Land and Water Conservation and natural resources departments were mentioned by less than 40% of farmers in both groups. It may be that these latter agencies had not been approached by farmers for support, as often agriculture is not seen to be part of these agencies' jurisdiction (although several of the farmers in each group were involved in agroforestry ventures with state Forestry groups, and it could be reasonably expected that they be involved in supporting changes made).

The EMP group was more satisfied than the EMS group with support received from family members, industry, other farmers, and state agricultural and natural resource management departments (Figure 25). The largest difference in satisfaction rankings was observed in the EPA category, where the EMS group was much more satisfied with support received than the EMP group. EMS farmers also rated the support from other farmers considerably lower than the EMP farmers. This reflects perhaps the general lack of knowledge about EMS in the farming community at the time of the study, and echoes comments made by some EMS farmers that they felt that their peers generally were not supportive of the changes they were making. It is likely that the two groups were

seeking somewhat different sorts of information, with the higher satisfaction ranking of regulatory agencies by the EMS group perhaps indicative of their need for more of the legal and compliance issues which may not have been sought by the EMP group.

In terms of overall satisfaction, the EMP group rated family, industry, staff, agricultural departments, and other farmers as the top five support mechanisms. For the EMS group, the top five rankings were family, staff, EPAs, researchers, and customers/neighbours (the latter two had equal ranking).

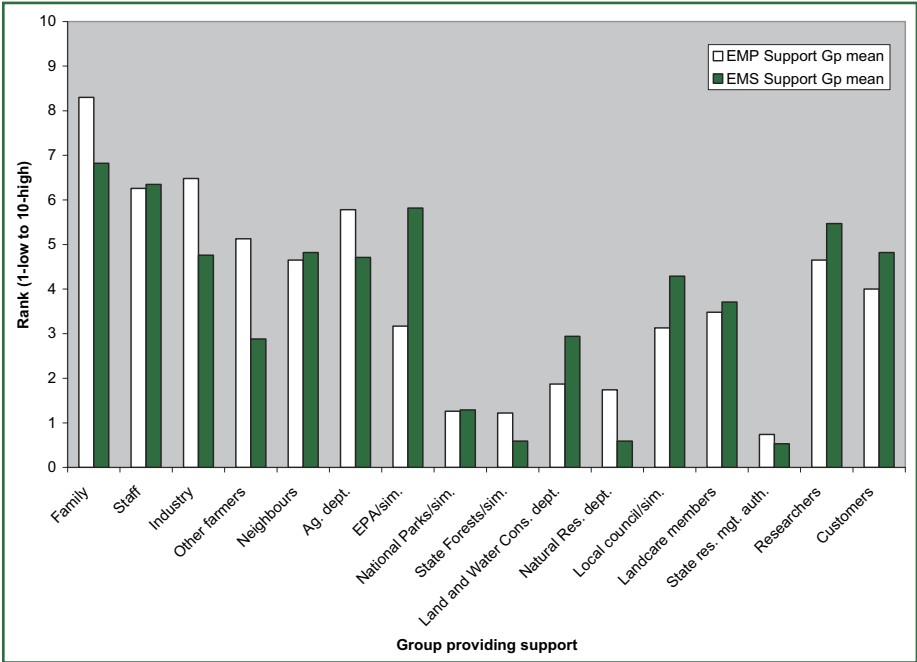


Figure 25 Group mean scores for support received

Involvement with changes

In both groups, involvement of family members, staff, National Parks, State Forestry, and state resource management authority staff were reported at the same levels as those of support. However, lower levels of involvement than support were noted for neighbours, agricultural departments, local councils and Landcare members (Figure 26).

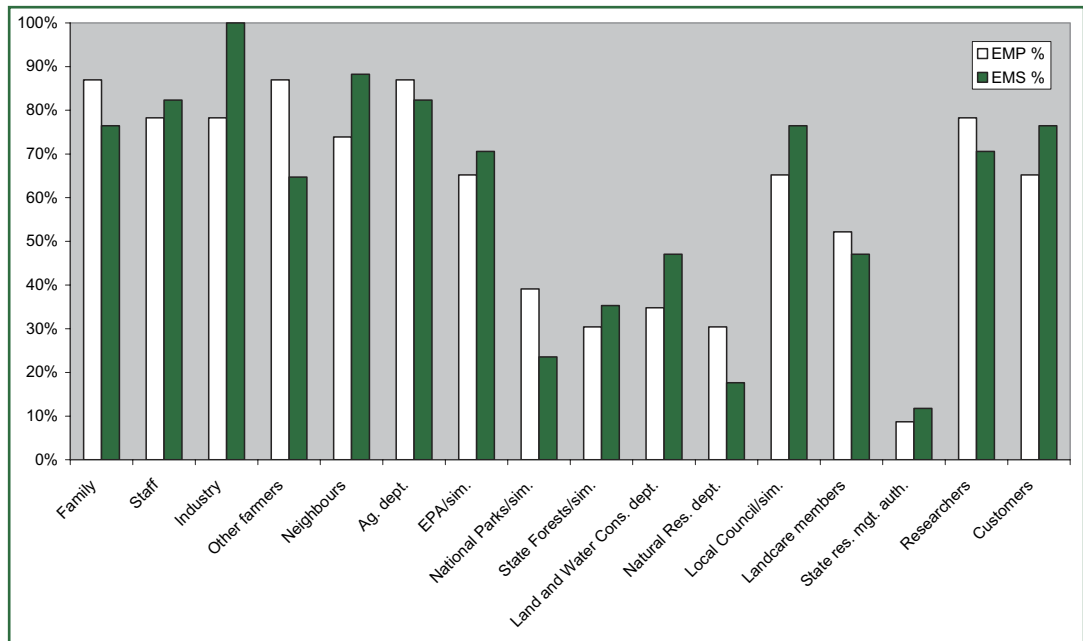


Figure 26 Involvement of groups when making changes to management

The EMP group reported lower levels of involvement compared with support for industry groups and natural resources departments, whereas the EMS group reported slightly higher levels of involvement than support for these agencies.

Other farmers and EPA staff were involved in making changes as often as in providing support for the EMP group, but less often in the EMS group.

Departments of Land and Water Conservation were equally involved and supportive for the EMP group, but more involved than supportive for the EMS group.

Finally, the EMP group felt that researchers and customers were more supportive than actually involved but the EMS group reported them to be equally involved as supportive.

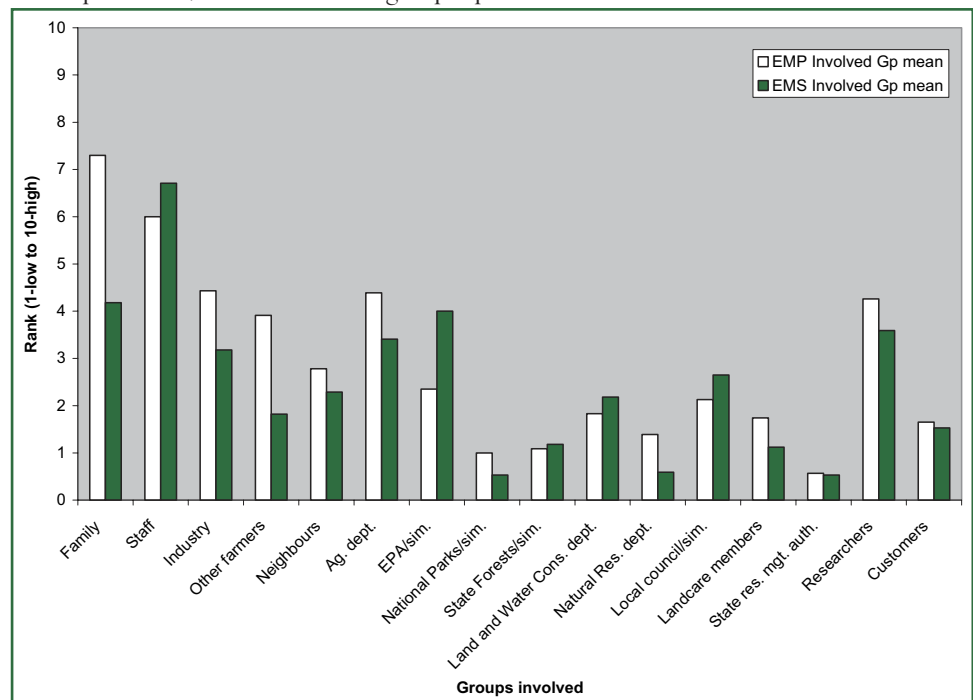


Figure 27 Group mean scores for involvement when making changes to management

Generally the group mean scores for involvement were lower (less than five for all groups other than family and staff) than those reported for support (Figure 27). The exception was the involvement of staff on EMS farms, who were ranked at higher levels of involvement than support. In addition, the EMP group rated researchers and customers as being more involved (although group mean ranks were lower) than the EMS group. The top five ranked groups involved in making changes in the EMP group were the same as those providing support, however, in this case, staff were rated more highly than industry. For the EMS group, the top five were staff, family, EPAs, researchers, and agricultural departments.

Peer support has been reported as a significant factor in EMS adoption, implementation, and maintenance. Ammenberg et al. (2000) described a program in Sweden where a group of SMEs in an industrial estate worked together to develop a joint approach to EMS. Many of the steps in developing EMSs were shared, resulting in cost and time savings, improved information flows, enhanced planning and a feeling of support and shared purpose. Several farming groups around Australia have started to work in a similar fashion, for example, the Minginew Irwin group in Western Australia and the Traprock Wool Association in Queensland.

Confidence can also be improved in a group situation, where members of the group have a good understanding of the enterprise engaged in. For many of the EMS farmers, a peer support network did not appear to be operating in the same way as the support networks available to other farmers who were focused on production-related issues. One of the valuable features of the Landcare concept is that it provides an avenue for farmers and others to work collaboratively on environmental issues, and may serve as a de facto support network for EMS farmers in early times when there are few farmers with an EMS. However, results from this study appear to show that while the EMS group valued the support received from Landcare more than the EMP group, the involvement of Landcare was rated lower. This may change as Landcare members become more aware of, and involved in, EMS.

3.14 Indicators and Monitoring of change

Typically within EMS, three major types of indicators are determined – management performance indicators, operational performance indicators and environmental condition indicators. Edwards et al. (2002) reported that 92% of businesses implementing an EMS reported some improved indicators, with 56% reporting improvement for at least half of the indicators measured. The ISO 14031 document (ISO 1997), which deals with environmental performance indicators, provides guidance for managers establishing monitoring programs, either in conjunction with an EMS or not. Løkkegaard (2000) described how the ISO 14031 format can be expanded to develop a simple EMS approach.

For farmers, determining the impact of a natural resource management approach is a long-term task, and a wide range of indicators can be utilised. Saunders et al. (1998) and SCARM (1998) provided reviews of the range of environmental indicators used

within Australian agriculture. Use of common indicators can allow for benchmarking of performance and practices, which is very important to allow emulation of good performances (Metzenbaum 2001). In Australian agriculture, programs such as TopCrop and the various forms of Maximum EconomicYield (MEY) Check programs are based on the provision of benchmarking actions that lead to highest yields or efficiencies. However, indicators chosen by natural resource managers and farmers will only be useful if they are matched with the management issues being addressed (Carruthers and Tinning 2003) and provide value in terms of data for use in routine management on-farm.

In this study, farmers were asked what indicators were monitored on-farm, how these were measured, the frequency of monitoring/measurement, and how the data were used in decision- making. Farmers were also asked how records were kept.

The categories of indicators being used by the farmers were grouped into environmental, business and output (see Figures 28 to 30). In Figure 28 (environmental), specific indicators have been grouped for clarity of reporting. For example, where farmers reported monitoring climatic conditions, they may have measured rainfall, temperature, wind speed/direction and similar indicators. Biodiversity may have been assessed through flora or faunal surveys, biodiversity audits, or through specific vegetation mapping.

Environmental indicators

Figure 28 shows the 15 different categories of environmental indicators that were reported. Soil nutrients and various water indicators were the most commonly reported categories. Approximately 60% of EMP and 70% of EMS farmers monitored soil nutrients. As this parameter is strongly linked to productivity, many farmers regarded this issue as being more to do with production than the environment. In contrast, soil health was monitored by less than of 15% of farmers in either group.

Approximately 30 – 35% of EMP farmers regularly monitored efficiency of water use, water tables and water

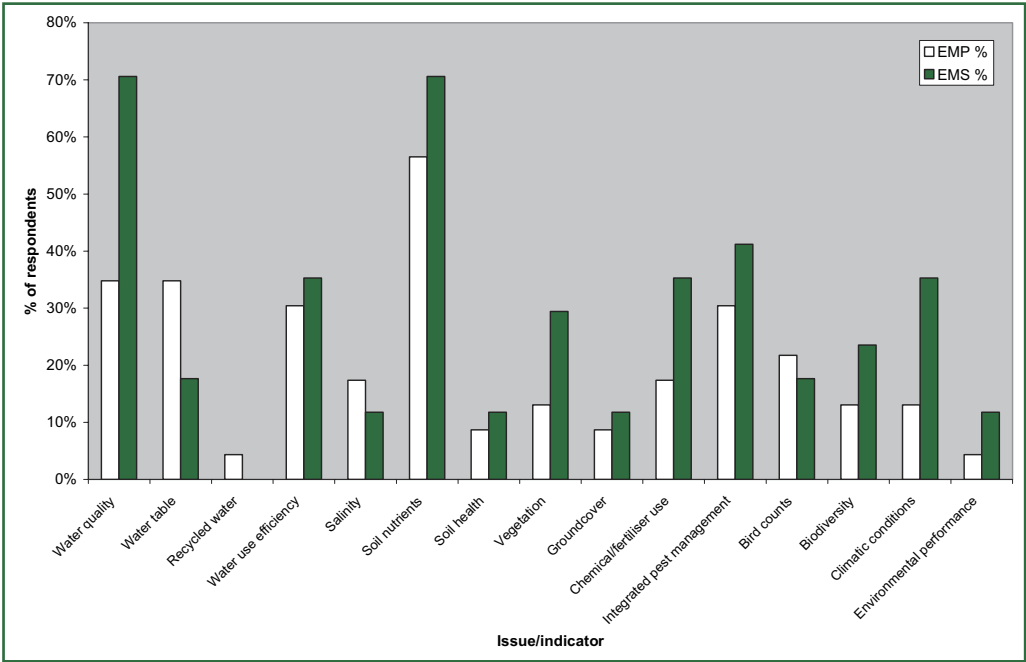


Figure 28 Indicators of change – environmental issues

quality (Figure 28). While about 70% of EMS farmers measured water quality, only 30% measured water-use efficiency and less than 20% monitored water tables. The greater attention paid by the EMP group to both water tables and salinity may be related to salinity being identified as the ‘crisis’ that initially prompted changes in on-farm practices.

Approximately twice as many EMS farmers reported monitoring chemical use as EMP farmers. This may link to the focus of the ISO 14001 Standard on both compliance and pollution prevention, but may also reflect the initial focus many of the EMS farmers had on community perceptions regarding agricultural practice, and use of chemicals in particular. Additionally, more in the EMS group monitored indicators relevant to integrated pest management (IPM). For IPM to be effective, close attention must be paid to both numbers of pest and beneficial species and chemical use, and this need for accurate and timely data may be the reason more attention is paid to these areas by this group. Similarly, the greater monitoring of climatic conditions reported by the EMS group may also relate to building an overall picture of information for management – risk assessment may be more accurately made in the light of good climatic data.

In terms of biodiversity-related issues, EMS farmers more frequently reported monitoring groundcover, vegetation on-farm, biodiversity, and soil health (which included soil biodiversity), while more EMP farmers reported bird counts as an indicator. Again, this data does not support the general contention that farmers using an EMS will not address biodiversity issues simply because this area is not specifically mentioned in the ISO 14001 Standard.

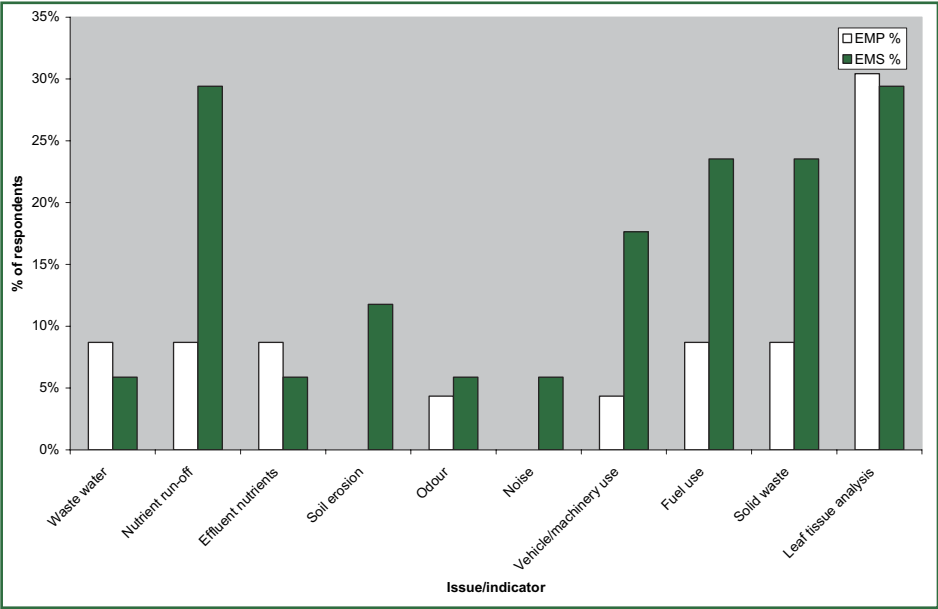


Figure 29 Indicators of change – outputs

Output indicators

More of the EMS than EMP group reported monitoring indicators to evaluate outputs (Figure 29). The exceptions were effluent nutrients and waste-water monitoring which are strongly linked to industry sectors such as intensive livestock, enterprises represented more commonly in the EMP group. In addition, approximately the same number of farmers in each group reported the use of leaf tissue analyses. Again this factor is strongly related to production issues, and is more

commonly used to evaluate performance in production rather than environmental terms. The EMS farmers also reported monitoring in two areas exclusively – noise (in one case only) and soil erosion. The greater proportion of farmers in the EMS group

monitoring ‘brown’ environmental indicators (fuel and vehicle/machinery use, wastes and noise) is linked with the wider range of issues identified in these areas by this group. Vehicle and fuel use, and waste disposal monitoring are linked with an increased attention to business efficiency – one of the stated aims of this group. These issues also assist with pollution prevention, an area specifically raised in the ISO 14001 Standard, and, at least for waste disposal, can be addressed under legislative compliance.

Business indicators

EMS farmers reported using six areas of business indicators: the EMP farmers used four, and did not monitor community relations and staff training (both ‘systems’-related issues) (Figure 30). More EMS farmers reported using financial performance indicators, with low numbers in both groups recording market appraisal, production, and complaints as an indicator of performance (this latter issue may be industry-linked, due to licensing requirements). The use of community relations indicators by EMS users is similar to the results reported in other industry sectors, and in this study may relate to the ‘public pressure’ driver expressed by the EMS group.

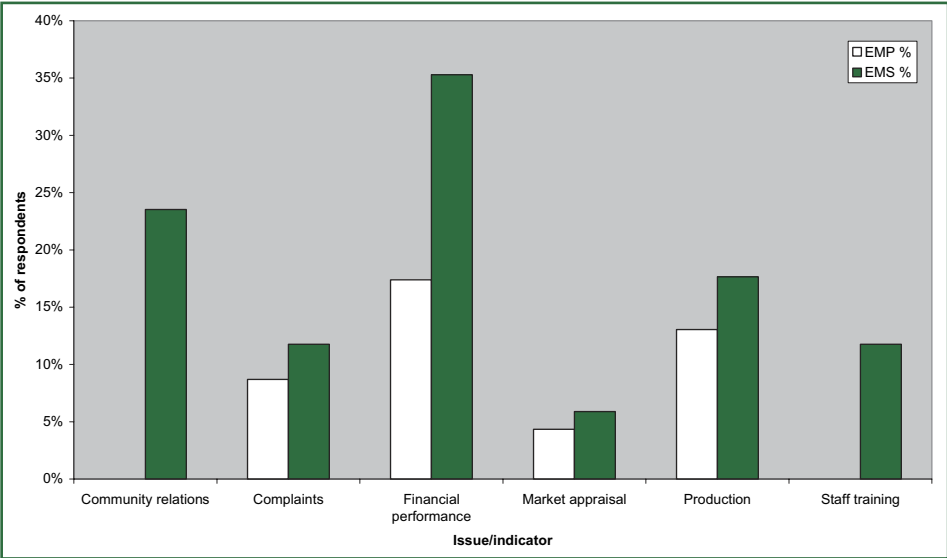


Figure 30 Indicators of change – business issues

The indicators and monitoring used reflected specific issues of concern and in some cases reflected requirements of other management approaches, such as QA and OH & S, or of licence requirements. Some managers had adopted a suite of monitoring methods and indicators that had been developed by industry, Landcare or other groups. To some extent, the results of the current study reflect those of Florida and Davison (2001), who found that EMS enterprises were significantly more likely to report using performance indicators to monitor regulatory compliance, waste/emission, and customer and community satisfaction. In this study, the EMS group generally reported using a wider range of indicators and, in many cases, a higher percentage of farmers in this group monitored the issues indicated. On average, the EMP group reported monitoring 5.4 items while the EMS group reported routinely monitoring 8.9 items.

The EMS farmers reported more detailed risk assessments to determine priority issues that were to be dealt with, and related the monitoring and indicators more closely to these risk assessments. This may partly explain why more EMS farmers monitored climatic conditions than EMP farmers – analysis of risk for farming requires good climate data to allow management choices.

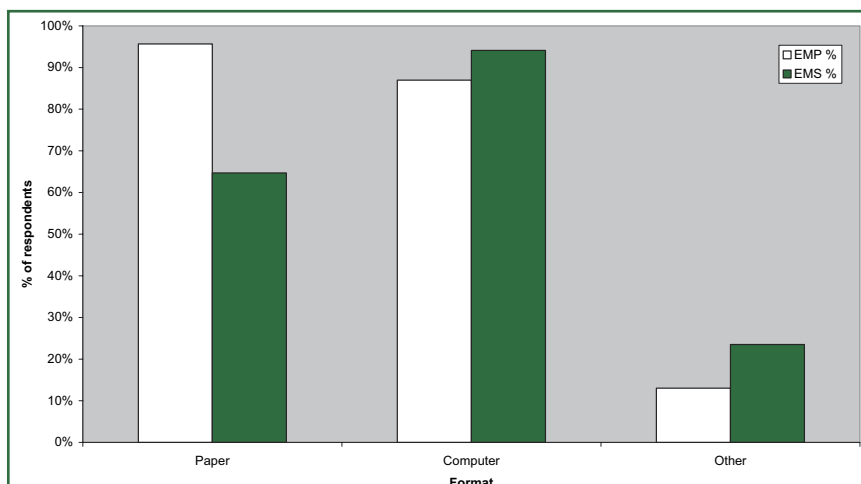


Figure 31 How records were kept

Record-keeping and use of monitoring results

While 96% of the EMP farmers indicated that they kept farm records in a paper-based format, 87% also used computers in some way with a further 13% using 'other' forms of record-keeping. These alternative records included maps, photographs, licences and similar documents (Figure 31). For the EMS farmers, computers (94%) were more often used than paper (65%) to keep records, and this group also made more use of other means (24%) of keeping

records than did the EMP group. Due to the small sample size, it is impossible to determine whether there are any real differences between methods of record-keeping between the two groups, although the EMS group appears to rely somewhat more on computers and 'other' methods than the EMP group.

Undertaking a comprehensive review periodically is a key component of an EMS. However, simply completing a checklist is not sufficient to achieve this outcome. It has been suggested that a simple checklist approach to self-assessment would be sufficient for farmers to demonstrate their environmental stewardship. However, Newbold et al. (1997) stated that while the LEAF (Linking Environment and Farming) audit in the UK was 'good as far as it goes', without feedback and an indication of where improvements can be made, a simple checklist is not sufficient to achieve outcomes, and a management system is needed. Much of the EMS work currently underway in Australia has focused

on the development of the checklists for self-assessment, rather than tackling the development of a full systematic approach. The current study attempted to determine the levels of review undertaken routinely by Australian farmers.

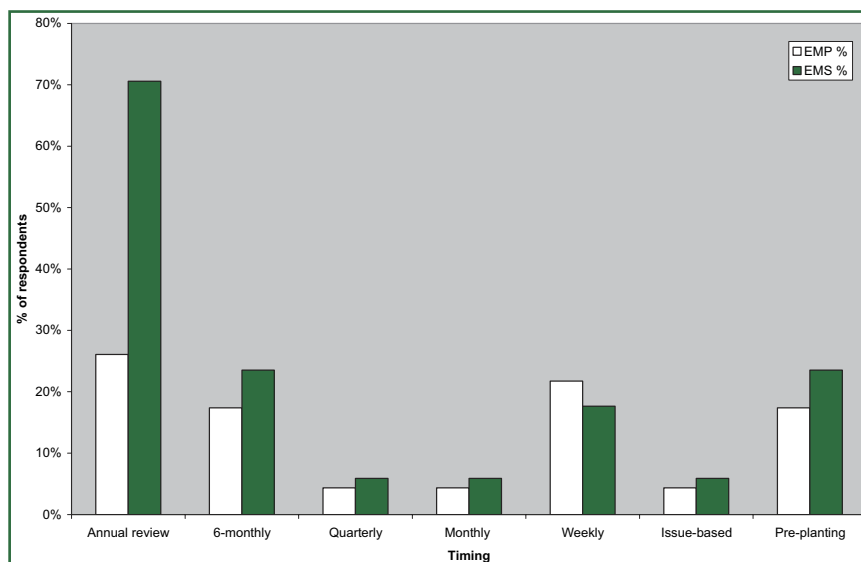


Figure 32 Use of monitoring results in decision-making

each group reported quarterly, monthly and issue-based reviews.

Review of monitoring results varied between the two groups (Figure 32). Over 70% of the EMS farmers indicated that they undertook an annual review of data, with less than 30% of the EMP farmers doing so. Slightly more EMP (25%) than EMS farmers (20%) reported that they did a review weekly, with equal numbers in each group reporting six-monthly and pre-planting reviews. Single farmers in

As at least an annual review of performance of the EMS is a requirement of the ISO 14001 Standard, the large number of farmers in the EMS group conducting an annual review is not unexpected. Those EMS farmers who were in the earlier stages of implementing their EMS often reported a shorter review cycle. Again, the groups answered this question from a different context. The term review has a specific meaning within an EMS framework, and it is likely that quite different methods and considerations were taken into account during the 'review' in the two groups.

Several farmers in both groups indicated that the Business Activity Statement required under Australian taxation law had meant that they now paid more attention to their financial performance, and saw the BAS reporting as a good time to reflect on overall performance. Many also indicated that the software they had purchased to help with their BAS work was useful in linking production costs more effectively into their overall considerations.

3.15 Effect on performance – environmental, financial and business

Corbett and Kirsch (2000) identified a number of potential areas of benefit arising from use of ISO 14001, and classified these into external (i.e. outside the business) and internal (i.e. those that directly affect the operations of the business) benefits. They found that there are numerous benefits to be gained, both internally and externally, by businesses implementing an EMS. Many other authors have reported similar findings for SMEs, notably Hilary (1999). Amongst South African businesses (Knowles and Hill 2001, citing Alheit and Keogh, 1999) the most commonly perceived advantages of EMSs are risk-based advantages such as compliance with legislation, improved environmental risk management and demonstrating due diligence. Improving company image and relationships with the public were also suggested as significant advantages. However, Ammenberg et al. (2001) cautioned that 'it is an intricate task to study the effects of the implementation of standardised EMSs' and this study is by no means a comprehensive evaluation of all possible benefits from either EMS use or enhanced environmental management.

As a first step in identifying what benefits might have been thought to be occurring as a result of adoption of either changed practices or an EMS, farmers in the current study were asked how management changes had affected environmental and financial performance (Figures 33 and 34). Benefits reported in this study often related to the individuals'

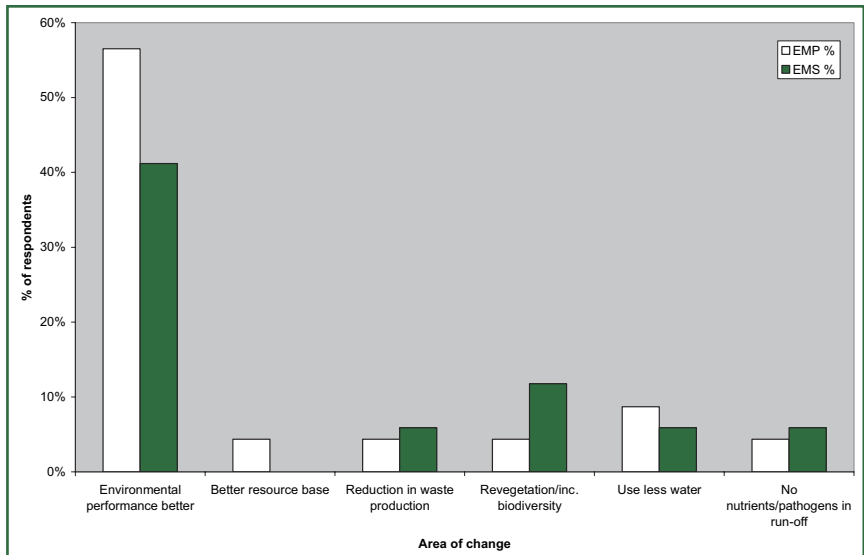


Figure 33 How have changes affected performance – environmental issues

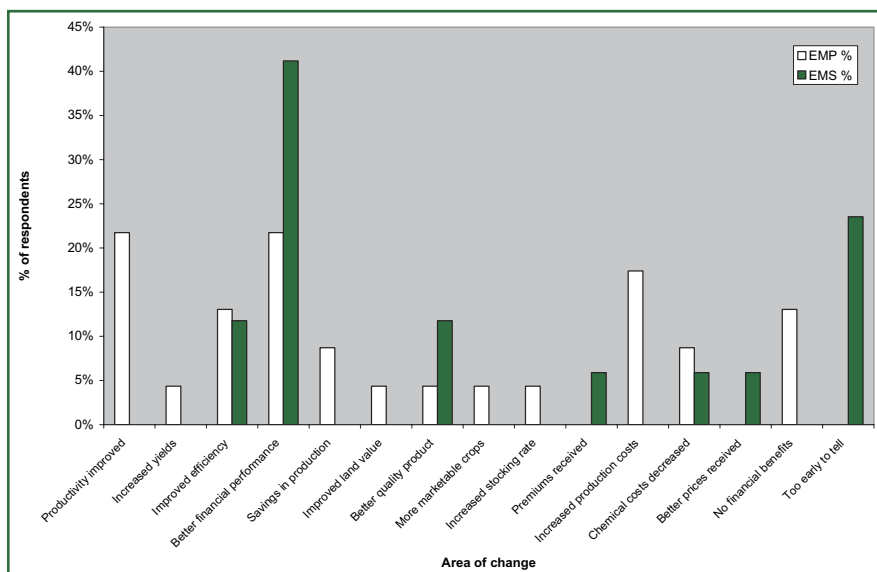


Figure 34 How have changes affected performance – financial issues

motivations for undertaking changes to management in the first place, and so were often discussed from the farmers' personal frame of reference. In responding to this question, farmers also raised issues that may be more accurately described as 'business' areas, and so these are shown separately (Figure 35).

Environmental performance

Approximately 57% of the EMP group and 41% of the EMS group reported that environmental performance was better following the changes made on-farm (Figure 33). This finding is similar

to that of Edwards et al. (2002) who reported that, of the 85% of the businesses studied who reported their EMSs had provided benefits, 45% reported improvement in at least half of their environmental indicators, with 18% reporting positive nett quantifiable benefits.

In this study, participants reported improved performance in the form of waste reduction, revegetation, biodiversity, reduced nutrients and pathogens in run-off, and decreased water use. However, few farmers in either group discussed specific changes. It is interesting to note that the EMS group less often specifically reported improved environmental performance than the EMP group. The EMP group used approximately half the number of indicators as the EMS group (5.4 indicators for EMP and 8.9 for EMS). Therefore it is possible that the EMP group were not reporting specific, measured changes, but rather general environmental improvements.

Several of the EMS farmers stated that they felt it was too early to comment on environmental improvements. It may be that they were more cautious in reporting improvements without specific data to back them up or it may also be that the EMP farmers, who often reported a greater period of making changes, had had longer to observe changes in performance. Further research in this area is warranted, with more detailed examination of performance in pre-determined and specific areas of environmental outcomes prior to, during, and after, EMS implementation. Such analysis has been an increasing trend in EMS application in secondary industry sectors (Edwards et al. 2002).

Financial performance

Over 40% of the EMS farmers reported that their financial performance had improved, as did approximately 20% of EMP farmers. In addition, just over 20% of the EMP group indicated that they had achieved improvement in productivity, which would add to financial performance (Figure 34).

However, around 20% of EMP farmers reported that they had increased production costs or that there were no financial benefits (with some relating these effects to quality assurance program demands). The EMS farmers did not report these issues. Around one-quarter of the EMS farmers indicated that, at present, they felt it was too early to say whether there were financial benefits. For some in this group, the EMS had not been in place long enough to begin to see the real costs involved; for others, part of the EMS development had been to allow for such scrutiny.

Two EMS farmers and one EMP farmer reported improved product quality, with single EMS farmers reporting receiving better prices and gaining a price premium. For EMP farmers, a wider range of areas of improved financial performance was reported, but in many cases, only one or two farmers mentioned these areas. A few farmers in each group also mentioned improved efficiency, which could also provide financial benefits.

It is difficult to judge whether there were any overall effects from EMS implementation, as baseline data for the two groups do not exist. However, almost twice as many EMS farmers reported better financial performance, and individual reports of price premiums and better prices were only received from this group. Again, this area is one where specific, targeted research is needed to provide more detailed information. Established baseline financial performance levels need to be determined prior to implementation of any management changes to provide a benchmark against which to measure changes.

Business performance

Most of the areas reported here fall into the 'internal benefits' category described by Corbett and Kirsch (2000). The major difference observed was that over 35% of EMS farmers, but only 9% of EMP farmers, reported improved communication, information, and confidence (Figure 35). All other categories were raised by one or two farmers only. These included greater control over their operations (one EMS farmer) and an enhanced ability to demonstrate progress (two EMS farmers) as a benefit of the changes they had implemented. Single farmers in each group mentioned reduced risk. The

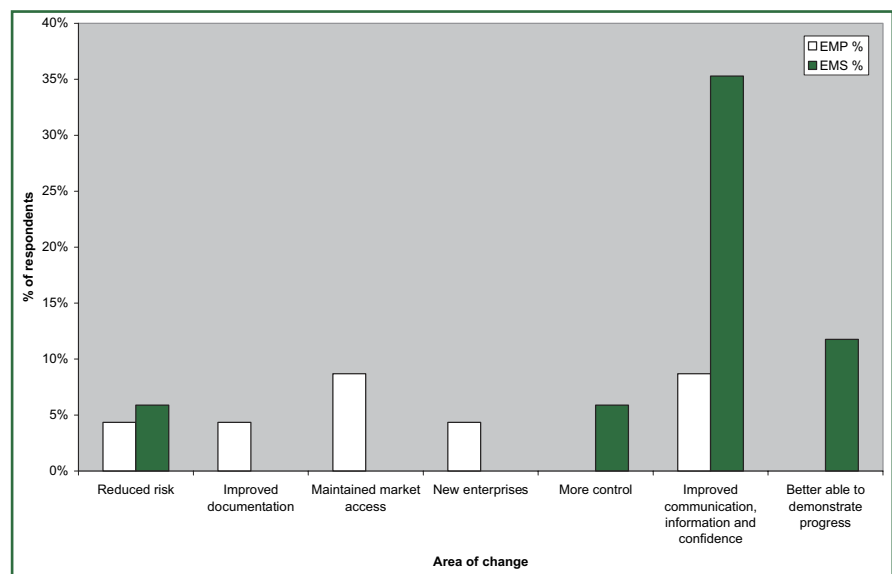


Figure 35 How changes affected business performance

EMP group also nominated three areas of business benefit not mentioned by EMS farmers, but again, only one or two individuals noted these changes. As the EMS farmers had been more motivated initially by public perception and pressure, the ability to demonstrate progress, confidence in management, improved communication and a feeling of greater control of the business are all important outcomes to reinforce management choices. It is also interesting to note that the EMS group did not nominate improved documentation as an outcome. This again challenges the notion that an EMS is 'all about paperwork' – if the key focus of an EMS user was only documentation, then this is an area that would be expected to be noted as a change. Either the EMS farmers in this study did not regard it as a major outcome, or they were already keeping a good level of documentation.

Business outcomes reported in this study are difficult to measure financially. A large degree of the benefit of EMS is likely to occur in the social area, rather than in the easier-to-measure financial features. This study highlights the need for novel ways to measure attainment of goals resulting from EMS implementation. Traditional methods of measuring the 'success' of changed practices are not sufficient to capture the sorts of benefits reported in the business management area.

3.16 Benefits and costs of changing practices

Benefits

Benefits arising from any changed practices serve as positive reinforcement to continued efforts. Florida and Davison (2001) observed that business benefits in particular serve as an important motivator for the adoption of innovative environmental practices. In Australian agriculture, the difficulty in quantifying benefits has been a particular barrier to increased farmer adoption of EMS. Many farmers are waiting to see exactly what benefits might accrue to those using an EMS before they are willing to invest in such practices themselves. This has also been reported in South African wineries (Knowles and Hill 2001) and amongst Canadian farmers (Wall et al. 1998).

The area of benefits was more fully explored, with interviewers asking participants what the major environmental, social, financial, market and legal benefits arising from adoption of improved management had been (Figures 36, 38, 40, 42 and 45, respectively). A prompt list of 20 categories was provided and farmers could nominate additional areas if required. For the environmental, social and financial benefits, farmers were further asked to provide estimates of the actual or perceived benefits that had occurred, with further details obtained from farmer comments. The results of these questions are shown grouped in categories (Figures 37, 39, and 41, respectively). Other benefits noted by farmers are shown in Figure 46.

Benefits were difficult to quantify fully, and many farmers included items with no direct financial measurement, such as confidence in management, improved community relationship/perceptions, and improved information resulting from monitoring and use

of indicators. The fact that these benefits cannot be evaluated economically, however, does not make them any less real, or pertinent to the individuals. In fact, for many of the intrinsically motivated farmers, it is possible that such ‘intangible’ benefits may actually prove to be the most rewarding and valued.

Environmental

Environmental impacts arising from production are, according to Andrews et al. (2001), signals of economic inefficiency in production that should be corrected. From a farming perspective, these impacts are also to be avoided so as to protect the reputation of the industry sectors involved. As obvious environmental impacts are reduced within farm management, it is likely that more subtle, perhaps longer-term and more difficult issues will be tackled, as long as there is a method by which farmers can become aware of these issues.

In the farming situation, the time scale question is exacerbated, as most of the environmental impacts arising from agriculture have taken decades, if not longer, to become obvious. Solutions applied will take a similar or longer time to show any outcomes. Many of the benefits reported below are based on the perceptions of the farmer reporting, and are not quantified in economic terms.

As noted by Steger (2000), quantifying the benefits of EMS implementation is difficult because many benefits occur over a long time frame and are related to perceptions, which are ‘neither measurable nor empirically verifiable’. Williams et al. (2000) found that one-third of businesses surveyed believed that EMSs would provide benefits –the perceived benefits included increased environmental awareness, improved corporate image and marketing, legal compliance, improved staff morale and reduced costs. These benefits were described before the businesses had embarked on doing an EMS.

When asked to nominate benefits observed from a provided list, an improved resource base was the major benefit most commonly reported (over 90%) by both groups of farmers (Figure 36). Both also reported improved or increased biodiversity levels, although the EMP group more commonly reported this. It is interesting to note that only one EMP farmer reported that management changes had affected performance in terms of the resource base in the earlier question (see Figure 33) – raising issues as to whether farmers saw changes in this area as benefits and not simply direct consequences, of changed practices.

When asked to estimate the environmental benefits, a wide range of categories was raised (19 by the EMP group and 16 by the

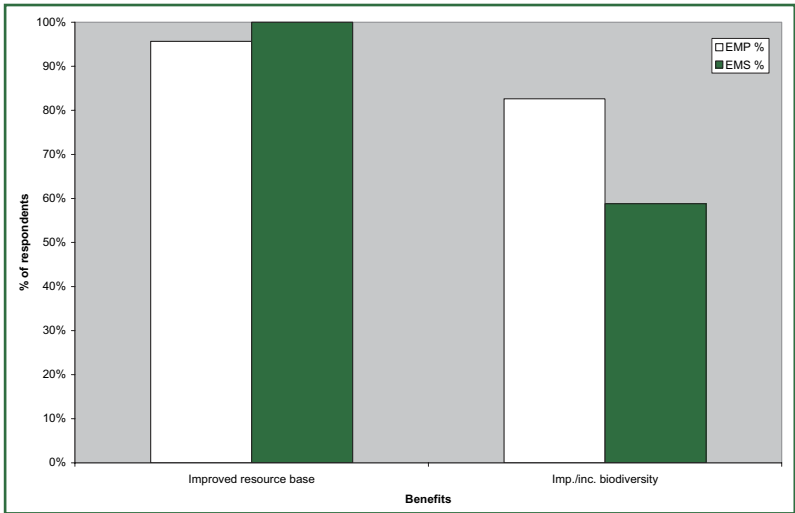


Figure 36 Environmental benefits from improved management

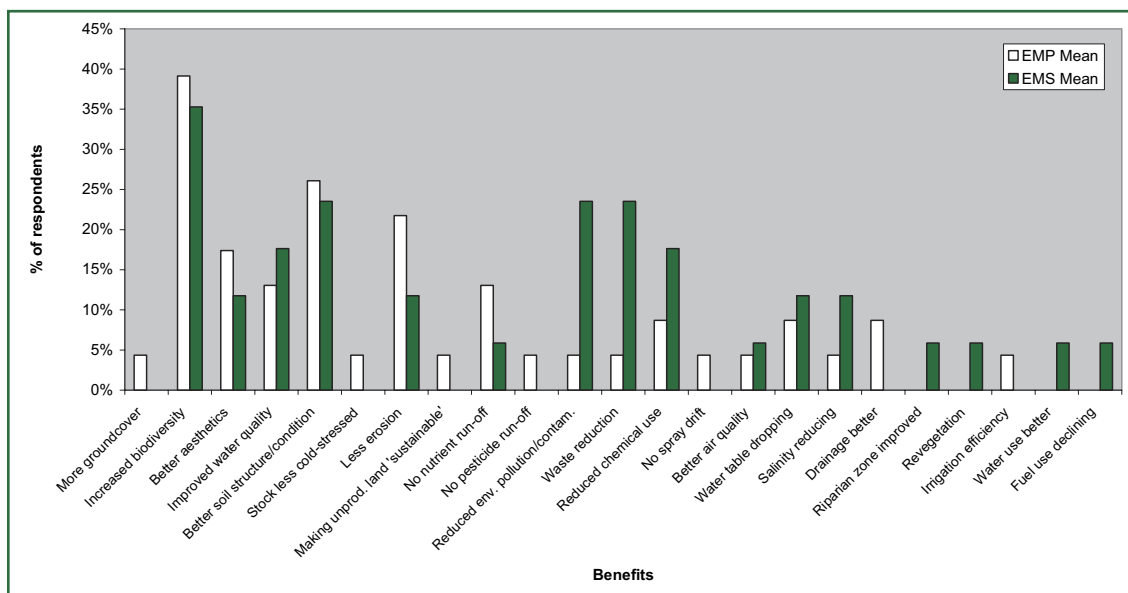


Figure 37 Environmental benefits (in depth) arising from changes

EMS group, with one EMP farmer also stating that chemical use had increased due to QA requirements). These are shown in Figure 37. However 10 of the areas of perceived or actual improvement were nominated by

single EMP farmers, and six improvement areas were nominated by single EMS farmers.

Changes in flora and fauna on-farm were becoming apparent to many farmers. Biodiversity was the most commonly nominated area of environmental benefit (approximately 40% of both groups), with improved soil structure and condition mentioned by around 25% of each group. In many cases, biodiversity changes assisted in pest control as part of integrated pest management (IPM) programs. Biodiversity changes were directly influenced by revegetation programs, and by the return of fauna to revegetated areas. Many farmers were undertaking periodic biodiversity surveys to assess the changes occurring.

The major difference between the two groups was the more common reporting by the EMS group of 'brown' environmental issues (such as pollution control and prevention, and reduction in wastes), whereas the EMP group reported erosion reduction, elimination of nutrient run-off and improved drainage (operational/production type issues) more frequently. Efficiency of resource use was also more commonly reported by the EMS group, with issues such as reductions in fuel, water and chemicals cited as environmental benefits. The EMS farmers also reported improved soil conditions and commented on reduced environmental contamination, and waste reduction, more frequently than the EMP group. This relates to the wider initial range of issues being addressed by the EMS group.

Similar outcomes in these areas have been reported by other researchers investigating the use of EMS in secondary industry applications (for example, Florida and Davison 2001). For enterprises of these types, reductions in environmental risk to the whole community occur when emissions, odours, noise, pollution and wastes are reduced through EMS implementation. Community benefit also accrues through reduced use

of resources such as water, fuel and energy. However, in the farming situation, such benefits are difficult to quantify effectively, as neighbours can be fewer and waste disposal costs relatively unknown. However, the community good arising from better management of these brown issues in agriculture is likely to be great, and warrants further investigation within the farming context.

Social

As outlined above, EMS use frequently provides a number of social benefits (Florida and Davison 2001). Social benefits were examined within this study, in terms of both on-farm and off-farm effects.

In response to the prompted list of social benefits, both groups reported three major categories arising from changed farm practices – greater peace of mind, more confidence in management and improved human health and safety (Figure 38). Slightly more EMP farmers reported improved OH and S and having greater confidence in their management, whilst more EMS farmers reported greater peace of mind. All other social benefits were reported in low numbers. Two EMP farmers and one EMS farmer indicated that they had received awards, but for EMP farmers, the awards received related to production-based achievements (such as highest yield competitions) rather than environmental outcomes.

In the detailed comments on perceived or actual social benefits, a better perception of the farm (within industry and/or community), confidence in self and management, improved occupational health and safety on-farm, and better-trained staff were social benefits reported by similar numbers of participants in each group (Figure 39). Single EMP farmers

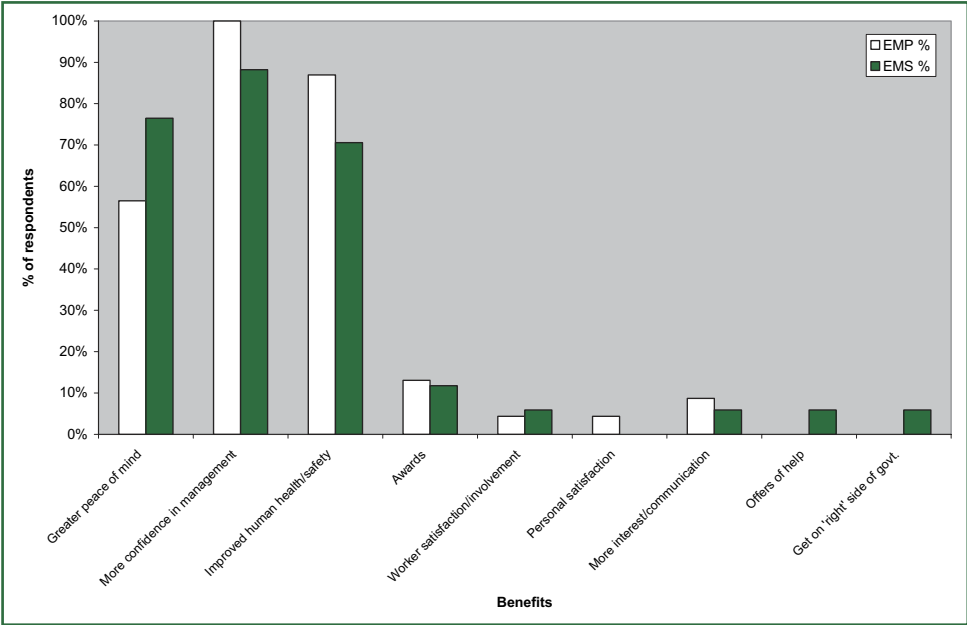


Figure 38 Social benefits from improved management

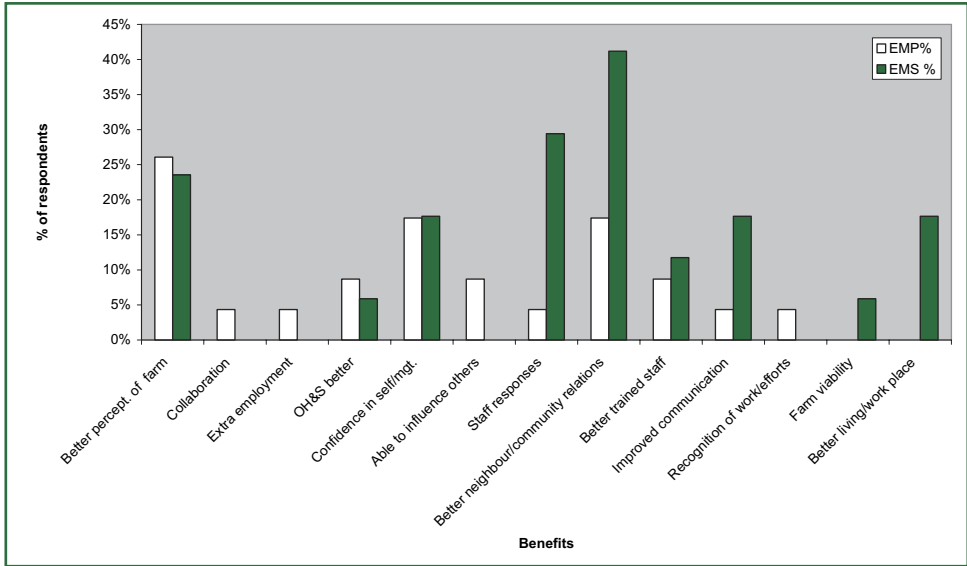


Figure 39 Social benefits (in depth) arising from changes

also reported improved collaboration, creation of extra employment in the area, and recognition of their efforts, with two farmers also stating the ability to influence others as social benefits arising from their adoption of enhanced environmental management. These benefits were not reported by the EMS group.

Farmers also often discussed the feeling that the community was seeing their industry in a more positive light because it was taking a proactive stance with regard to environmental management. In some cases, this was even affecting the interactions of spouses and children in the community.

EMS farmers reported more frequently than EMP farmers the responses of staff to environmental initiatives, improved community relations and communication. Specific to the EMS group, enhanced farm viability and improved living and/or working conditions on-farm were also raised. The 'improved relationships with neighbours and community' reported by this group perhaps again reflects that one of their initial drivers was community/neighbour pressure – it is possible that the EMS farmers were specifically looking for positive outcomes in this area. Welford (1996) suggested that ISO 14001 might provide a common language that both enhanced communication about environmental management and created a common way of thinking about it. As farmers in Australia often lament, their communication with those outside the agricultural industries is often hampered by a lack of understanding of the practicalities of farm management. If communication can be streamlined to eliminate at least some of the areas of confusion, then the remaining areas of difficulty may possibly be easier to deal with. This facet of EMS implementation could be useful to pursue in the future.

The staff responses commented upon by the EMS group may have arisen due to the requirement in the ISO 14001 Standard to address both communication and training for those assisting with environmental management. The involvement and support of staff was also seen as important when making changes, and so again, the EMS farmers may have been looking for changes in this particular area.

Interestingly, several of the EMS farmers also discussed the information benefits they received while undertaking an audit. They stated that the auditors were able to provide suggestions for improvement, which were then built into the next iteration of farm planning. This benefit has also been observed in other industries (Corbett and Kirsch 2000).

For some farmers, their stewardship was seen to be providing the whole of their industry with an improved image, and many case study participants were actively engaged in provision of information and advice to other farmers, as well as to regulatory agencies and industry groups.

Around 30% of each group stated that they had received some form of community recognition for their environmental work. For the EMP group, such acclaim included being members of the Greenhouse Challenge (9%) or the Land for Wildlife program

(approximately 20%). Single farmers in the EMS group were involved in these programs, and mentioned the National Packaging Covenant, an Australian Conservation Foundation partnership, and use of farm front gate signs as mechanisms for achieving community recognition of their environmental stewardship.

Financial

The EMS farmers reported nine categories of major financial benefits (including one report of a premium gained for produce), and EMP farmers listed five. The majority in both groups reported improved stock/crop health (Figure 40). Better profits and better yields were also frequently commented on in the prompted list of benefits. Two of the EMS farmers reported reductions in licence fees. Single farmers in both groups mentioned reduced workers' compensation insurance premiums; one EMP farmer nominated tax/rate relief; and three EMS farmers cited other benefits.

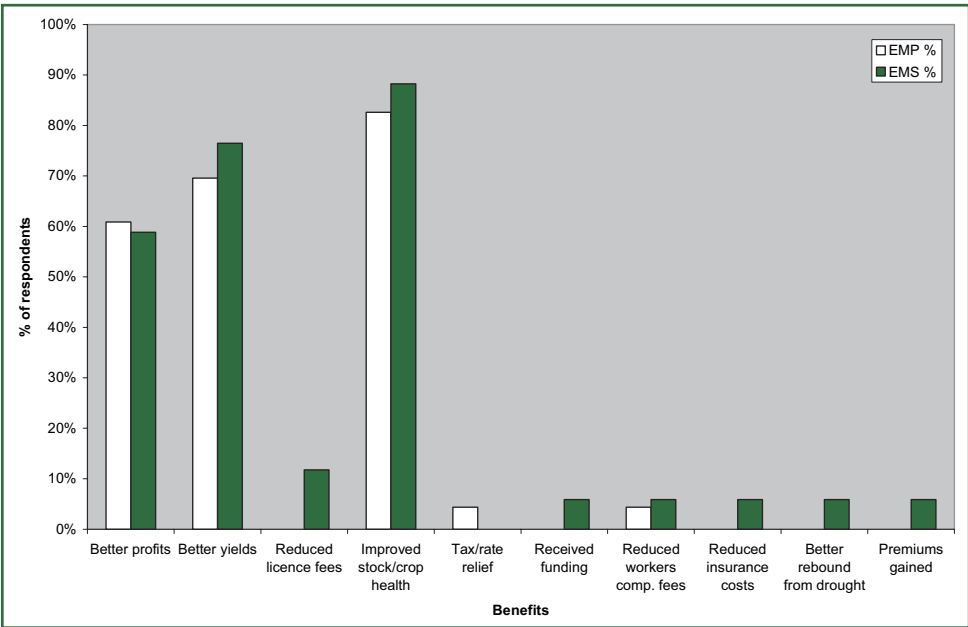


Figure 40 Financial benefits from improved management

Detailed comments on financial benefits were provided by only a third of farmers in either group. The most commonly reported financial benefit by both groups was savings in input costs – 29% for EMS farmers and 17% for EMP farmers (Figure 41).

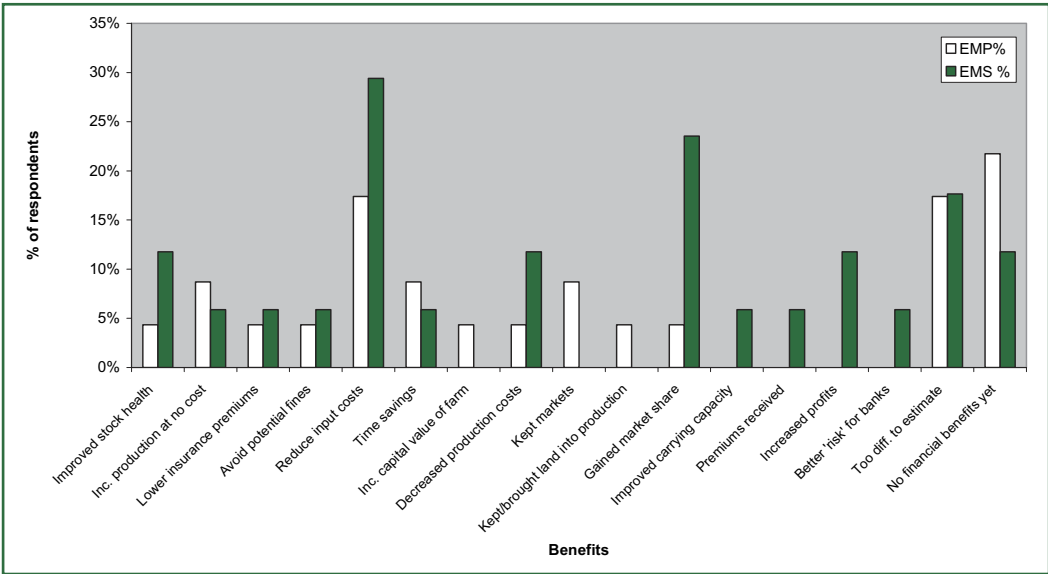


Figure 41 Financial benefits (in depth) arising from changes

Specific estimates of financial benefits were provided by five EMP farmers. Farmer 1 stated that he was gaining an additional \$20 per hectare from production increases, for no extra costs. Farmer 2 estimated that he was 10% 'better off' financially. Farmer 3 said that they were saving between 30% and 40% on their past pesticide use rates, but did not provide actual cost figures. Farmer 4 said that the

reduction of fertiliser use, resulting from better nutrient budgeting and use of effluent, meant that fertiliser input costs had dropped from \$25,000 per year to only \$2,000. Farmer 5 stated that chemical use had dropped by over 50% as a result of management changes.

One EMS farmer reported a drop of 95% in pesticide input as a result of using integrated pest management, different crop varieties and more careful monitoring. This resulted not only in significant cost savings (estimated at approximately \$200 000 in the first year), but also in greatly reduced environmental burden. Another EMS farmer reported that, by bringing cattle into a weed control program and adopting an integrated pest and weed management approach, substantial declines in herbicides and pesticides costs of between \$30 000 – \$50 000 annually had been achieved. 'Improved profits of greater than \$100 000 per year', a 'five-fold nett increase in returns', 'increased nett returns by a factor of 8', '\$50 000 more profit in the last 12 months', and '20% more profit' were estimates given by five other farmers. One farmer reported a 20% increase in demand for his product, with the additional benefit of other farmers seeking to join in his management and marketing approach. One farmer in the group estimated that he had become '30% more efficient' in his management, saving both time and effort. As a result of introduction of minimum tillage and improved herd management, one farmer estimated that he was making \$190 per hectare more for his sorghum (due to increased yields) and an extra \$5 – \$10 per head for cattle (due to improved herd health). A final farmer in this group stated that the carrying capacity of previously unreliable land had improved three-fold and that the need for autumn feeding of stock had been greatly reduced (again providing cost savings).

These savings and efficiencies were sometimes off-set by cost shifts. For example, savings in pesticide inputs were sometime matched by payments to pest management or IPM consultants, water-use efficiency measures were sometimes gained by using improved water monitoring technology. Many farmers recognised these cost shifts, but believed that the added benefits of employing more sustainable practices would ultimately provide a long-term advantage.

More EMS than EMP farmers reported decreased production costs; however, three farmers in the EMP group reported that they had increased production at no further expense. Farmers in the EMS group also cited improved carrying capacity, receiving premium prices, increased profits, and being a 'better risk' for lending institutions as benefits. The EMP group was more likely than the EMS group to mention keeping access to markets, with three EMP farmers indicated that their changes allowed them to retain markets. However, approximately 25% of the EMS group reported gaining an increased market share – a benefit reported by only a single EMP farmer.

Reduced risks and liabilities (environmental and occupational health and safety) and avoidance of potential fines were more often reported by farmers involved in intensive livestock industries. In at least three cases, reductions in insurance and workers' compensation premiums were achieved as a result of addressing OH & S issues as a

part of farm management. A single EMS farmer also stated that they now represented a better risk for banks.

Florida and Davison (2001) observed that improved surrounding property values had been reported in areas where businesses were taking more account of environmental management. This potential was explored by Nind (2001, 2002) within the agricultural context in Australia. The valuers-general in several states have begun to examine the use of EMS as a measure of farm land-value. Thus, financial benefits of improved environmental management may apply over a wider scale than just the individual property on which changes are made.

For both groups, approximately 20% of farmers felt that, at present, it was too difficult to estimate what financial benefits they were gaining from improved resource management. In some cases, this may have been due to the immaturity of the management approach, but some farmers stated that the financial benefits were not as important as the environmental and business management outcomes they were observing. This response may also reflect the general difficulty in evaluating environmental outcomes (Edward-Jones 1993), and the lack of criteria against which to judge performance (Edward- Jones et al. 1992).

Finally, 22% of the EMP farmers and 12% of the EMS farmers stated that they had gained no financial benefits. For some, this was due to the fact that they had not yet begun to ‘market’ their achievements, and financial benefits were hoped for in the future.

Market

As market benefits were either occurring or hoped for by some of the farmers, this area was explored more closely. Steger (2000) reported that, at least in Europe, the market chain linkages vital for generating market benefits from EMS adoption are lacking. In part, this is due to the small number of businesses that currently have an EMS in place. Quality assurance programs have been driven in Australia largely by major domestic supermarket customers demanding suppliers address quality and food safety issues, but so far these demands have largely ignored environmental effects of production. The effect of such demands is evident in the responses of the farmers noted below.

The EMP group more commonly reported gaining approved supplier status, improved market access and publicity (Figure 42). Many in this group reported that these

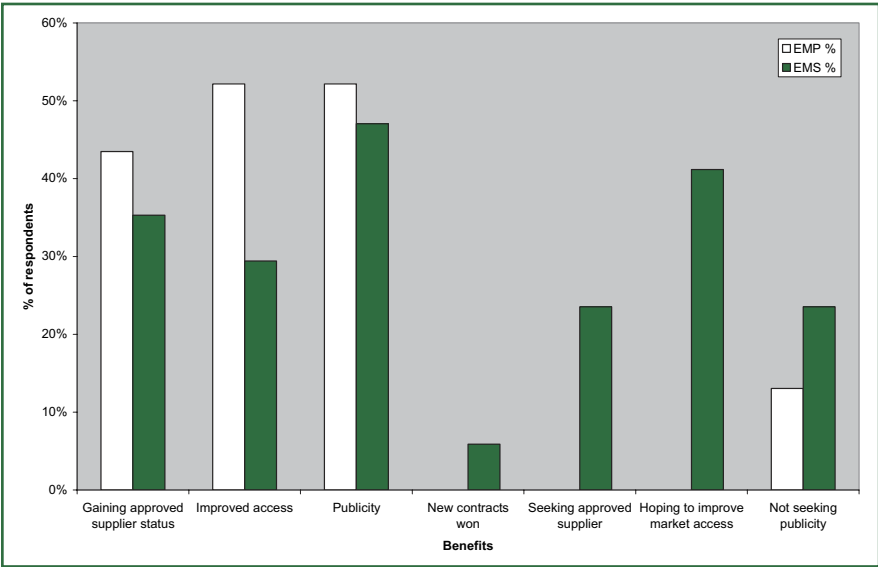


Figure 42 Market benefits from improved management

benefits had occurred because of their quality assurance programs, rather than their environmental work. One EMS farmer reported gaining new contracts as a result of their EMS, and several indicated that they were in the process of seeking approved supplier status on the basis of their environmental performance. One EMS farmer also reported gaining access to a Japanese market and the right to use the Japanese ISO 14001 Standards recognition logo on packaging materials for products into Japan, when they supplied a copy of the EMS certificate and audit reports. As Japan has the highest number of ISO 14001 certifications in the world, the ability to align product with internationally recognised standards is of significant use in marketing.

In responding to this question, the EMS group limited their responses to benefits occurring strictly as a result of their EMS, whereas the EMP group reported more generally on business performance. More EMS than EMP farmers indicated that they were not seeking publicity for their environmental works (24% compared with 13%).

Marketing environmental management

A number of farmers in both groups had commenced promoting their work using environmental labels. One EMS farmer reported gaining a price premium of \$6 per box of product because of their 'environmental credentials' and associated marketing campaign. Another EMS farm had experienced a 40% expansion in sales, at a time when other farmers in their industry reported a significant downturn. Customers of this farm stated that they were preferentially sourcing the product due to the 'environmental friendliness' that could be demonstrated through the EMS. More EMS than EMP farmers indicated that they were not currently seeking any publicity regarding their environmental work, possibly linked to the discomfort created by negative peer pressure that some in this group reported.

Around 40% of EMS farmers were hoping for improved market access and saw that their environmental stewardship positioned them well to quickly take advantage of any consumer demand for 'green' produce. However, most reported that current consumer demand was still focused on food safety, and so QA audits were sufficient to meet present demands. Many also felt that more formal approaches to environmental stewardship would be 'required' in the future, so saw their adoption of increased environmental management as 'getting ahead of the pack'. Corbett et al. (2003) noted that 'having ISO 9000 certification [of a quality management system] does not actually increase market share or profits, but not having it will lead to a decrease in market share or profitability.'

One of the difficulties that will be faced by farmers wishing to take advantage of the marketability of an EMS is that most consumers are unaware of what an EMS is or does. It is likely that education of consumers will be required before they exert market pressures. The novelty value of EMS, which in one way enhances its marketability, is also a drawback. However, the experience within the organic industry, with steadily growing consumer awareness, demonstrates that marketing particular 'green' characteristics of products is achievable.

Approximately 40% of EMP and 35% of EMS farmers were 'marketing' their environmental management in some way (Figure 43); around 30% of EMP and 35% of EMS were not, and approximately 30% of both groups indicated that they planned to do this in the future. When asked if this had changed over time, 44% of EMP and 24% of EMS farmers said yes, and 31% of EMP and 41% of EMS farmers said no.

Approximately 50% of EMP and 60% of EMS farmers were differentiating their products in some way in the market place. Individual EMP farmers were using a range of seven categories of product differentiation, some of which had been developed by the individual. The EMS farmers reported using either quality or environmental certification logos as a means of product differentiation. Around 35% of EMP and just over 50% of EMS farmers reported branding or labelling of products; two EMP and three EMS farmers used specific brands on products. One EMS farmer also reported the use of an integrated pest management label.

Some of the market differentiation gained arose from the use of certified or audited approaches (see Figure 44). More EMS farmers (76%) than EMP farmers (61%) had gained certification to various standards or programs. Nine EMS farmers had achieved ISO 14001 certification for their farm management systems at the time of interview and three have subsequently done so. The EMS farmers were also more likely to have certification against the ISO 9000 Standards. Corbett and Kirsch (2001), Edwards et al. (2002) and others have discussed the link between ISO 14001 and 9000 certification. Single EMS farmers also reported HACCP, SQF 2000, Woolworths Vendor Quality Management Scheme, Therapeutic Goods Administration Good Manufacturing Practices certification, or had quality assurance program development underway.

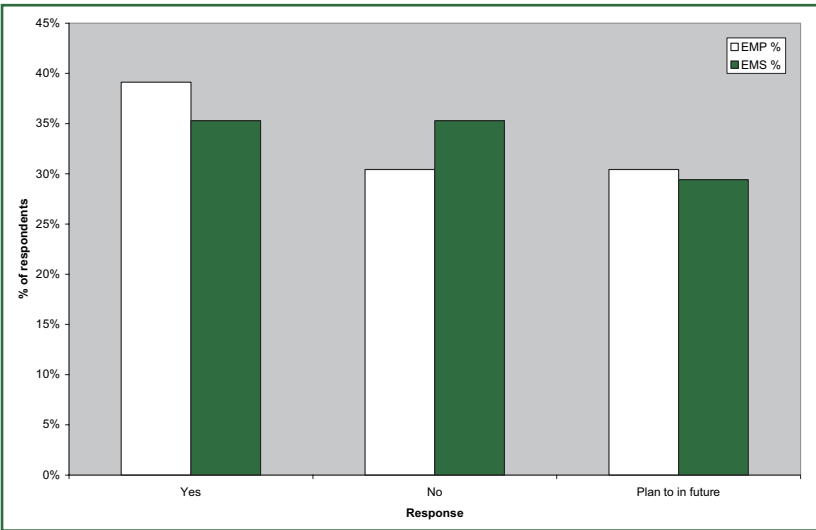


Figure 43 Were farmers marketing their environmental management?

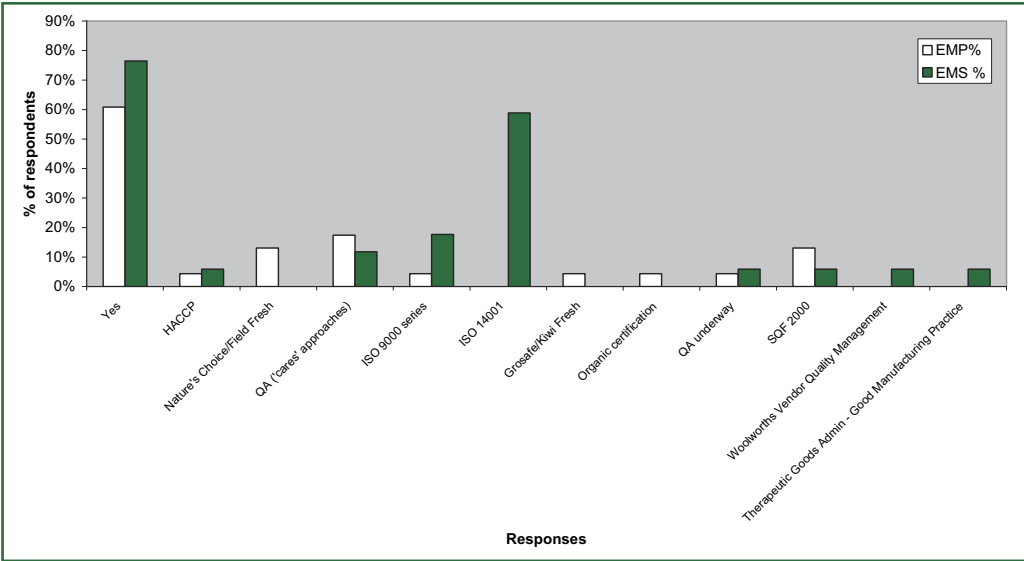


Figure 44 Had certification been sought or granted?

Low numbers (20% or less) of the EMP group reported accreditation against one of the ‘care’ programs such as CATTLECARE, Flockcare, or GrainCare. Single EMP farmers had certification against HACCP, ISO 9000 or an organic standard, and three to SQF 2000. Three EMP farmers had been recognised through the Natures Choice program, and one by a New Zealand program, Grosafe/KiwiFresh.

Business

In assessing the business benefits of changing practices, both groups reported that they now needed to spend less time fixing environmental problems (65% EMP and 77% EMS). One EMS farmer attributed this to staff training and communication, and indicated that, by clearly writing things down, there was less chance of confusion amongst farm staff and/or contractors. One farmer in the EMP group also reported that having a more ‘business focussed’ approach was beneficial. Two EMS farmers suggested that ‘learning by doing’ was a benefit of their approach. Steger (2000) reported that implementation of EMSs led to a more effective organisation and information flow within businesses studied and a higher degree of legal compliance.

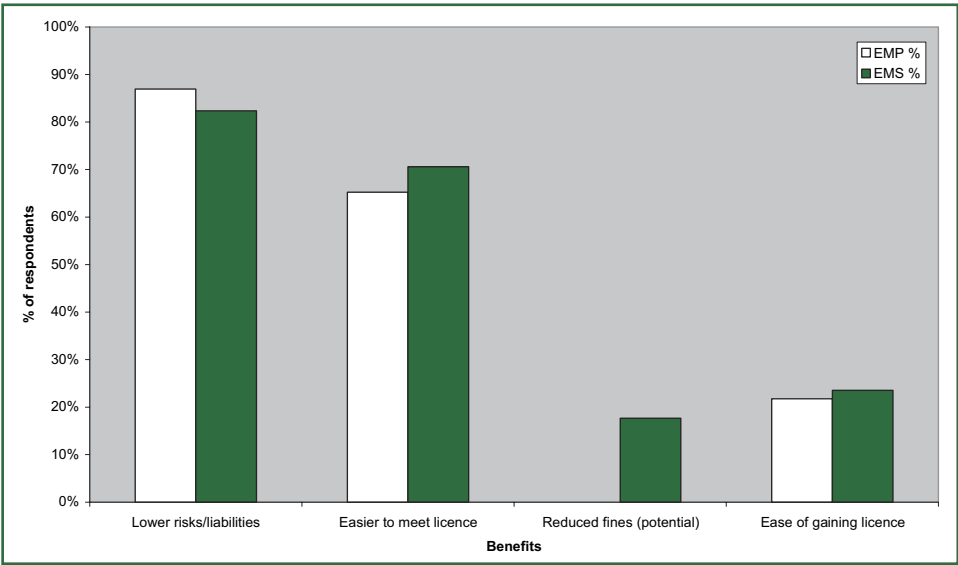


Figure 45 Legal benefits from improved management

Legal

Four categories of legal benefits were reported (Figure 45), with three common to the two groups. Approximately 85% in both groups cited the lower risk/liability profile they presented, ease of meeting licence conditions (approximately 70% for both) and ease of gaining licences (approximately 20%). Around 20% of EMS farmers also nominated the potential for reduced fines in the event of an environmental incident (although none reported actual incidents as having occurred).

Other

The other benefits observed by farmers are shown in Figure 46. It is interesting to observe that, apart from personal satisfaction and improved farm aesthetics, none of the categories are common between the two groups. The EMP farmers most commonly noted personal satisfaction as a benefit, whereas confidence was the most frequently observed benefit within the EMS group. Single individuals only raised all other categories. Corbett and Russo (2001) pointed out that many of the benefits arising from EMS

implementation, such as staff morale, are often intangible. The current study found that farmers reported increased confidence and feelings of 'being in control', most probably due to undertaking a more proactive planning role. Whilst intangible, these benefits are possibly the ones of most value to individuals, and are most likely to provide strong motivations to continue with management approaches.

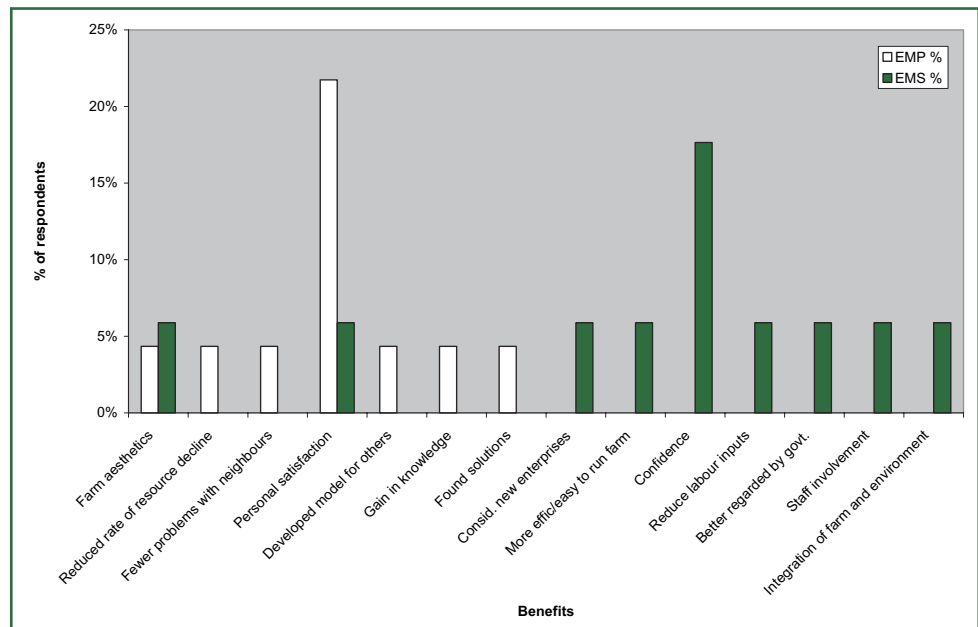


Figure 46 Other benefits noted

Relationships between issues addressed, reported indicators, and benefits found

In order to assess whether there was any relationship between the issues being addressed, monitoring being done and benefits reported, a simple regression analysis was conducted. Mean numbers of issues addressed were 5 for the EMP group and 32.5 for the EMS group; mean numbers of indicators used were 5.4 (EMP) and 8.9 (EMS); and the mean numbers of benefits reported were 12.8 (EMP) and 12.4 (EMS).

A significant relationship between the numbers of issues and indicators was found in both groups, but the relationship was stronger in the EMS group (EMP – $r^2 = 14\%$; $p = 0.07$ and EMS – $r^2 = 42\%$; $p = 0.004$).

A relationship existed between issues being addressed and benefits reported, but this was not statistically significant. Again, the relationship was stronger in the EMS group (EMP – $r^2 = 3\%$; $p = 0.46$ and EMS – $r^2 = 11\%$; $p = 0.18$). No significant relationship was found between indicators and benefits reported (EMP – $r^2 = 3\%$; $p = 0.41$ and EMS – $r^2 = 15\%$; $p = 0.12$).

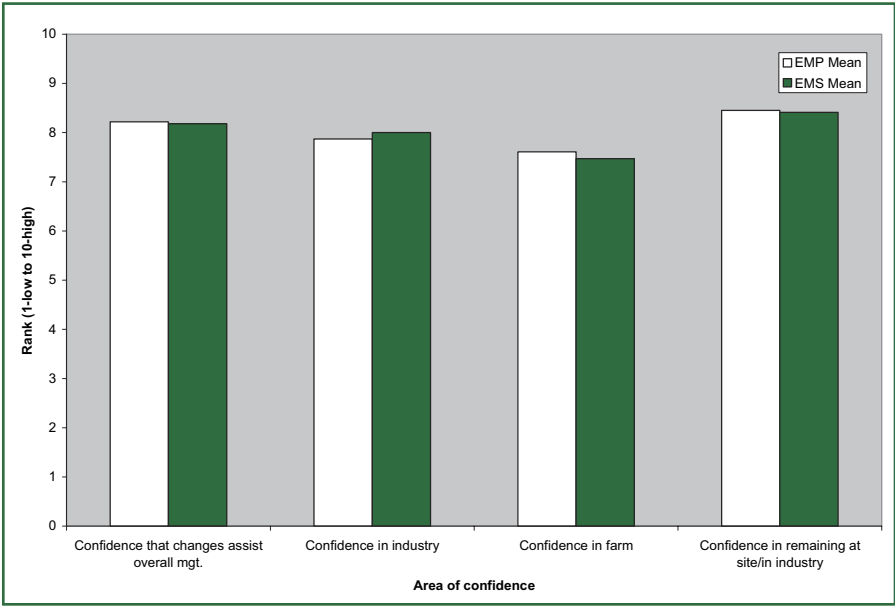
While the small numbers of farmers included in the study make firm conclusions difficult to draw, it appears that the EMS group was more closely matching the issues addressed with indicators used, and was somewhat more likely to be able to relate benefits reported with issues addressed. The lack of relationship between indicators and benefits reported may indicate that benefits reported by either group may be more perceptual than actual, but further data would be required to definitively draw such a conclusion.

Confidence

Farmers were asked to rank their confidence (from 1 – low to 10 – high) in four areas. These were:

- confidence that planning and management changes assisted in overall management, and why they felt that way
- confidence in the future of the industry, and why they felt that way
- confidence in the future of the farm, and why they felt that way
- confidence that their investment/ changes would assure future farming in the current industry sector and/or at the current site.

Farmers were also asked whether their confidence in the industry and/or farm had affected their investment in environmental management. Cary et al. (2002) reported that farmers were more likely to invest in new resource management practices when they felt secure in their financial future. One of the factors that promoted adoption of such practices was having a farm plan. Therefore, EMS farmers may have become more inclined to continue with EMS implementation as they went through the process, as active planning promoted confidence, and thus increased investment.



Responses from the two groups were similar (Figure 47) with mean confidence rankings (when calculated using all 23 and 17 farmers in both groups) differing only by 0.03 to 0.14 rank points for any category. This indicates that the groups were at similar levels – confident that their changes assisted with overall management, confident in both the future of the industry and the farm, and in remaining in their industry or at their site.

Figure 47 Mean confidence rankings (full groups)

Factors influencing confidence that planning and management changes assisted with overall management

Both groups cited “more planning” as the predominant reason for confidence that changes had assisted in the overall management of the farm (35% of the EMP group and 41% of the EMS group). The improved knowledge gained through their management approaches was cited by approximately 30% of the EMS group, but only 9% of EMP farmers as the reason for their confidence in management. Four of the EMP group and two of the EMS group stated that their management was now “better directed” (presumably as a result of undertaking more planning). Two farmers in each group stated that management changes meant they were better able to measure progress or changes in performance.

Single farmers in the EMP group raised the changes made, improved efficiency, observation of results of changes, and commitment, as reasons for confidence. Two EMS farmers cited improved efficiency and commitment, and one stated the use of systematic management overall, as reasons for confidence.

Factors influencing confidence in future of industry

When asked why they felt the way they did about their confidence in the industry, the EMP group raised 11 ‘positive’ and nine ‘negative’ areas of response. Most of the positives involved marketability of product, changes in farmers’ attitudes and market capture. Reasons for lack of confidence were costs of diversification, poor relationships/communication with processors, lack of vision in farmer marketing and crops grown, the threat of imports, fickle markets and deregulation.

The EMS farmers mentioned 15 ‘positive’ and six ‘negative’ reasons for their rankings. The positives centred on industry adoption of environmental management, supply of good-quality produce, gaining stakeholder support, and using a range of technology, research and infrastructure. The main areas perceived as ‘negatives’ were export threats, poor and uncoordinated industry response to environmental issues, and the lack of management skills within the industry.

Factors influencing confidence in future of farm

While group means showed similar levels of confidence in the farm, one EMP and three EMS farmers did not answer this question. If confidence ranks were calculated using only the numbers of farmers who responded, then confidence in the future of the farm differed (Figure 47a). The EMS group was 1.12 rank points higher. This would beg the question why the EMS farmers might be more confident in the future of the farm than the EMP farmers. Perhaps the EMS felt that they had made significant changes and that these changes would provide more certainty of the farm remaining viable, or that through more defined planning, they felt that they had planned to be there for the longer term. Alternatively, the EMS farmers may have felt that, while they couldn’t control the industry, they could control matters within their own sphere of influence – their farm – and had made plans accordingly to take control. As the EMS group was more likely to nominate increased confidence in management as an ‘other’ benefit, the

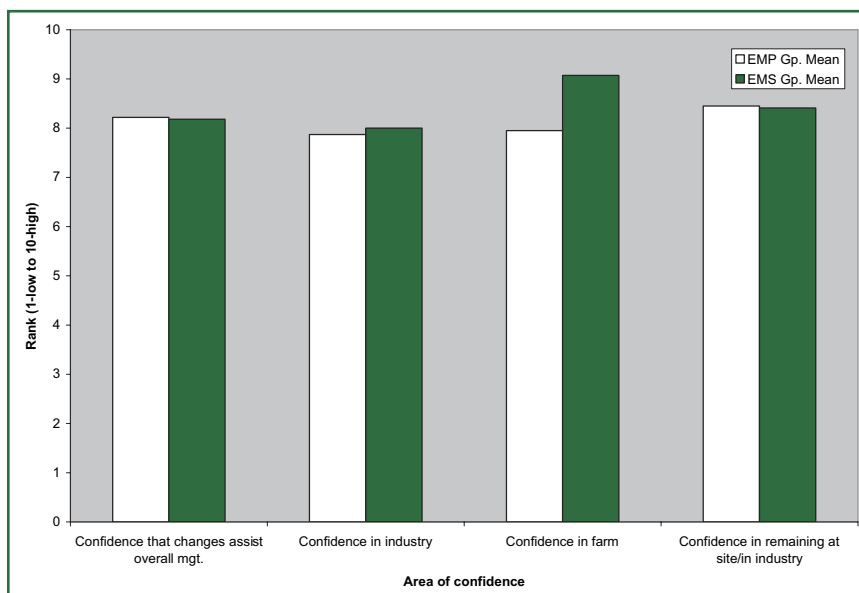


Figure 47a Group mean confidence rankings

answers given regarding confidence may be reflecting this perception.

Confidence in the future of their farms was influenced by similar factors to confidence in the industry. Again, EMP farmers tended to supply more negatives, but in this case also cited more positives. Issues generating confidence for the EMP group included increased productivity, better environmental performance on-farm, reduction in risk, improved planning, reduction of inputs and associated costs, and meeting market requirements (17 issues were raised).

Areas promoting apprehension about the future included urban encroachment on farm land, impacts arising from other

farms, lack of labour, economic pressures and children not wanting to continue working on the farm (10 issues raised).

For the EMS farmers, continuous improvement, maintenance or enhancement of the environment and production, reliability of information used to make decisions, greater control, proactive management and market acceptance/support were all raised as issues promoting confidence in the future of the farm (13 issues raised). Two members of the EMS group cited small farm size and the influence of government and market changes as reasons for lack of confidence.

Factors influencing confidence in remaining on farm/in current industry

The EMP farmers mentioned meeting legislation, having changes to underpin their management, and their long-term participation in site rehabilitation as reasons for confidence in remaining on their farms or in their industry. Five areas were discussed as reasons for lack of confidence. These 'negatives' were; not being able to 'control nature', having limited influence off-farm, problems in remaining at the current site, future odour concerns, and not wanting to stay in farming in the long term.

For the EMS group, areas generating confidence included dealing with issues as required, being more self-sufficient, reducing environmental impacts, gaining security of tenure on-site, diversification/expansion, meeting customer demand, seeing environmental outcomes, 'feeling' better and having sustainability as an overall approach. Only one issue was raised as 'negative' by this group – drought.

Did confidence affect investment in environmental management?

When asked whether their confidence had influenced investment in environmental issues, there were again slight differences between the groups in reasons expressed. Confidence had influenced spending on the environment for 70% of the EMP group and 94% of the EMS group.

Some farmers in both groups mentioned that they would be spending more on the environment in future, and both groups raised the increase in confidence gained by improved planning. The EMP group also mentioned that they wanted to gain premiums, had embarked on improved resource management to retain markets, and that diversification had spread risks. Spending money to improve their current site and its natural resources was seen to be beneficial, and one farmer remarked that he was now 'not spending money that they haven't got' (due to improved planning).

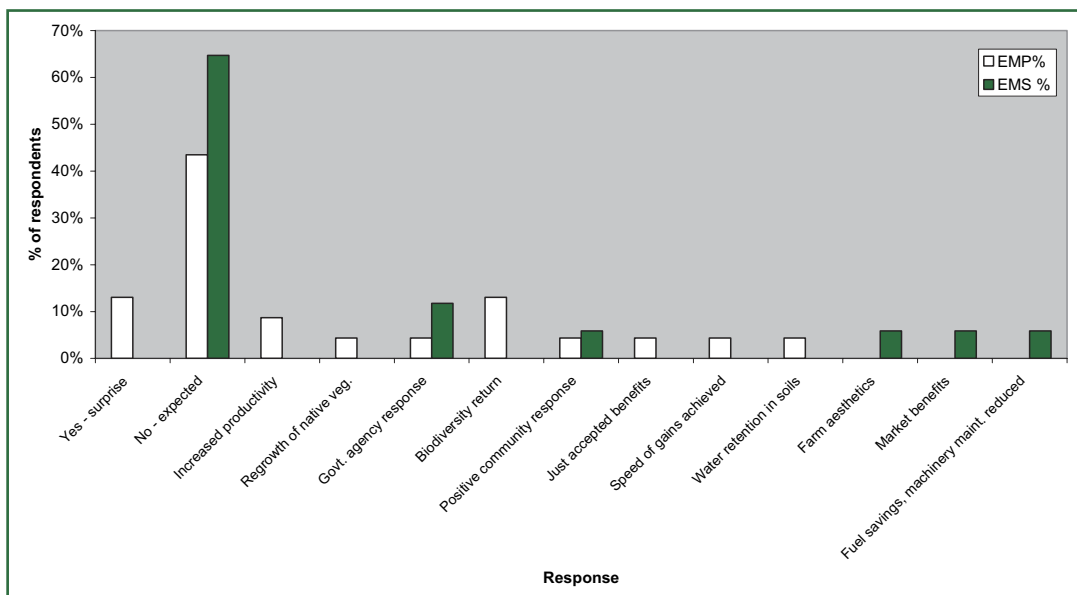
The EMS farmers more often mentioned the philosophy behind what they were doing (with comments such as 'environmental management has become the overall platform for how we do business', 'proving that environmental farming works') and the confidence of staff, stakeholders and farmers. They also noted the benefits; eco-efficiency, having an increased emphasis on management, improvements on the 'bottom line', and increased profits. These benefits then allowed further investment in environmental management.

On the negative side, EMP farmers raised the cost associated with planning environmental management as one area preventing further investment of time/money, with one farmer indicating that investment would only continue whilst prices were good – should prices decline, investment in the environment would stop. The only negative issue raised by the EMS group was the acknowledgment by one farmer that spending on an EMS would not solve all the problems faced by the farm. However, this farmer also stated that he had not gone into EMS as an economic decision but because of a desire to improve the environment on the farm.

Were benefits expected?

Figure 48 shows the responses of farmers when they were asked whether they had expected all the benefits that they had observed because of changing practices. A greater percentage of EMS farmers indicated that they had expected the benefits. Around 15% of farmers in the EMP group had been surprised by the benefits that had occurred. It is possible that the EMS group was 'less surprised' than the EMP group because they had undertaken a more risk-focussed planning process, and therefore were looking for specific outcomes arising from management changes made.

The response from government agencies was mentioned by one EMP and two EMS farmers, with single farmers in both groups stating that the positive community response was also a surprise. Three farmers in the EMP group mentioned being



surprised by the increase in biodiversity, with two in this group also being surprised by the increase in productivity. Other responses were not common between the groups, and only single farmers mentioned these benefits as surprising.

Figure 48 Were benefits a surprise (and if so, what were they)?

Did management changes make it easier to assess benefits?

Over 50% of both groups indicated that management changes had made it easier to assess benefits (Figure 49), with the EMS group again having a higher proportion of farmers making this claim. Both groups had similar numbers of farmers indicating that their changes allowed them to keep better track of information, with approximately 40% of the EMP group and 12% of the EMS group attributing this to records assisting with management. Again, the EMS group may not have focused on record-keeping and the use of records as something novel, because they may already have kept more and/or

better records than the EMP group initially.

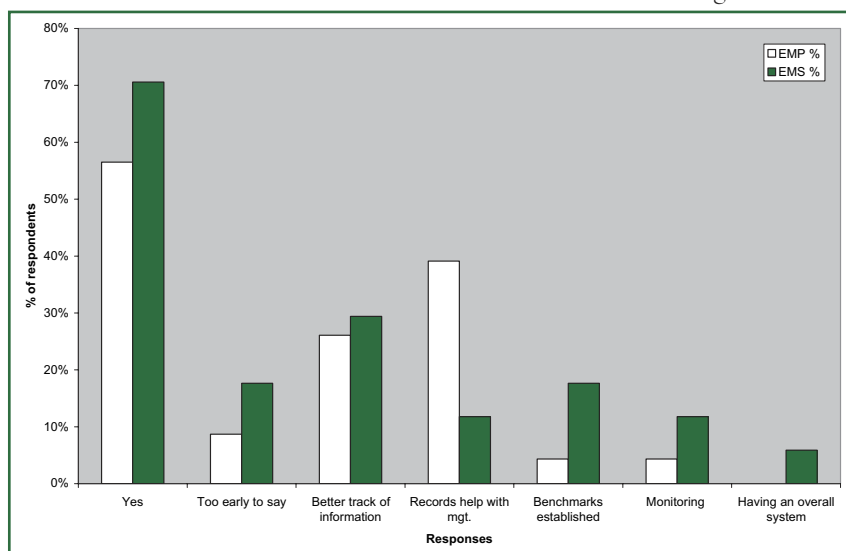


Figure 49 Did management changes make it easier to assess benefits, and why/how?

Around 20% of the EMS group cited the establishment of benchmarks against which to assess performance and the use of monitoring as reasons for more easily assessing benefits. One farmer in this group stated that having an overall system was the reason. A few farmers in both groups indicated that they felt it was too early to say whether their changes had assisted in assessing benefits.

Costs

Steger (2000) examined cost-benefit analyses of EMS implementation in the industrial sector and concluded that the results were fragmented and contradictory. He noted that reporting on costs depended very much on who answered the question, with EMS consultants usually providing cost estimates of approximately one-third of those supplied by the companies' estimates. He noted a further difficulty – the fact that there is no common agreement on what features or actions should count towards the cost of an EMS.

Knowles and Hill (2001 citing Davy 1997) suggested that for South African wineries, 'costs associated with an ISO 14001 EMS are likely to be relatively high, particularly for companies without a well-defined business management system. Costs include fees for consultants assisting with the establishment of the system or the cost of employing an environmental manager'. This assertion, however, ignores the potential for development of an EMS within the business, and also assumes that help must come from outside the business. As many of the farmers included in this study reported that they had largely developed their own EMSs or environmental management programs, the costs of gaining assistance or information may be reduced. There is also the possibility of working as a group to develop the EMS (Riddiford 1999) or for sharing costs for consultants between group members. Costs may also accrue to EMS users from any marketing or consumer awareness-raising that may be conducted, based on the EMS outcomes (Knowles and Hill 2001).

Mech (2002) suggested that implementing and certifying an EMS had two key cost components – cost of acquiring information and costs of certification. As it is possible to use an EMS process without certification, the common area between the two groups of case study farmers discussed here would be the costs of acquiring information to make changes to their environmental management (which may have arisen from training courses or have been purchased from consultants). The EMS farmers were also seeking additional information – that specifically about EMSs.

In this study, farmers were asked to outline the costs they encountered when changing their management. They were provided with a 'prompt' list of eight categories where they may have spent time or money (training, consultancy fees, infrastructure/equipment, new staff, monitoring, administration, software, and audits). In responding, some farmers reported the exact cash costs spent on particular areas of environmental management; others included their labour costs; still others included both of these, plus any follow-up costs for monitoring and maintenance. In addition, many farmers did not separate environmental management costs from production costs. Anecdotal information from the interviewers indicated that EMS farmers were more likely than EMP farmers to have more records and information relating to the costs of making changes on-farm but, in general, neither group had comprehensive records on costs.

The proportion of farmers indicating expenditure in these areas is shown in Figure 50. To accommodate those farmers who did not want to disclose actual financial data,

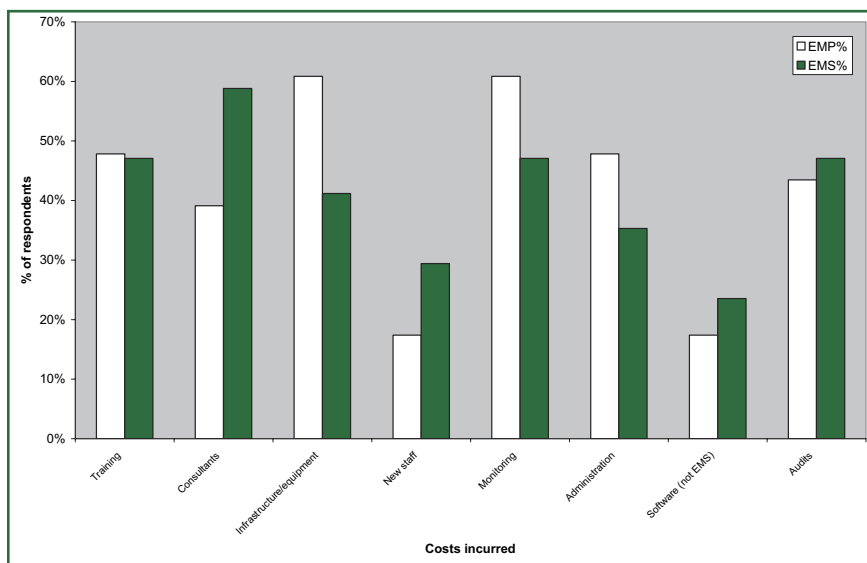


Figure 50 Categories of expenditure for changes

an estimation of time taken to make changes was also used as an answer in some cases.

It was difficult for many of the farmers to determine accurately the costs of changes they had made, or to separate the costs of environmental management from those of running the farm. This is not surprising, as most industry sectors worldwide are in the very early stages of adoption of true environmental accounting (Lamprecht 1997). As the maturity of the systems grows with time, data regarding accurate costs of environmental management is likely to be generated.

Similar numbers of farmers in both groups reported expenditure for training (approximately 50%) and auditing (approximately 45%). The latter finding is interesting, as EMS farmers were generally undertaking a wider range of audits (see section below). Similar numbers of farmers in each group also reported expenditure on new staff and non-EMS related software.

Infrastructure/equipment and monitoring were the most frequently reported expenditure categories by the EMP group (both approximately 60%), with expenditure on administration in about 50% of cases. Reporting of expenditure in this area was higher than that reported by the EMS group (35%). Approximately 40% of the EMS group reported infrastructure expenditure, and 47% reported monitoring expenditure – both less than the EMP group.

The EMS group had a higher proportion of farmers reporting costs for consultants (59%). Therefore, this study partially supports Mech's (2002) claim that gaining information is likely to be a cost for farmers implementing an EMS (in the higher reported use of consultants), but not totally, as training costs were reported at similar levels. Corbett and Kirsch (2000) also raised an interesting point – the cost of gaining certification is limited, the cost of not doing so is likely to grow over time. It would appear that a one-off expenditure might be a long-term cost-saving strategy in some cases.

Contrary to a commonly held belief in Australia that EMS adoption always involves great additional expenditure (particularly for infrastructure), the results of this study indicate that there was often little difference in reporting of expenditure on infrastructure, development, monitoring, and auditing costs between adoption of EMS, EMP and other management systems (including QA). In addition, statements regarding the costs of

farm EMS adoption in Australia made by some researchers appear extraordinarily high when compared with costs quoted for secondary industry application (Edwards et al. 2002).

Expenditure on specific areas

Farmers were asked to estimate what they had actually spent on the various areas, when making changes. general, the EMS farmers were more able to quantify funds spent on environmental matters specifically, whereas EMP farmers were more likely to report overall costs of operations (although this was not always the case). Again, the two groups tended to answer the question from a different perspective – the EMP group including all operations, the EMS group more often restricting their answer to the changes made in adoption of a systems approach.

Training

Training costs ranged from \$100 to over \$10 000 (Figure 51) with eight of the nine EMP farmers who provided training cost estimates reporting training costs of less than \$2000. However, this group tended to report only the training course fees, and generally did not include staff time/salaries, travel and accommodation in their estimates of training costs. For the EMP farmer who reported the highest training costs, these additional areas were included.

For EMS farmers, single individuals reported training costs from \$500 to \$10 000, and 2 farmers spent more than \$10 000. For both of these farmers, the costs were for internal EMS auditor training of several staff members, and one business included all the additional expenses cited above in the estimate of costs. Within these businesses, training costs were being recouped through provision of consultancy/auditing services to other farmers. For the EMS group, completing auditor training was seen as a way of gaining further understanding of how systems might be audited, and as a way of enhancing overall systems implementation. Many farmers in both groups also stated that training had been subsidised through farm training programs, by customers, industry sector, or various agencies.

In terms of time spent, the EMP group reported spending between two and 18 days a year on training, with none of the training relating directly to environmental issues. In the EMS group, five of the six farmers reported specific environmentally related training, with times spent ranging from four to 14 days per year. Two of the six completed environmental auditing training.

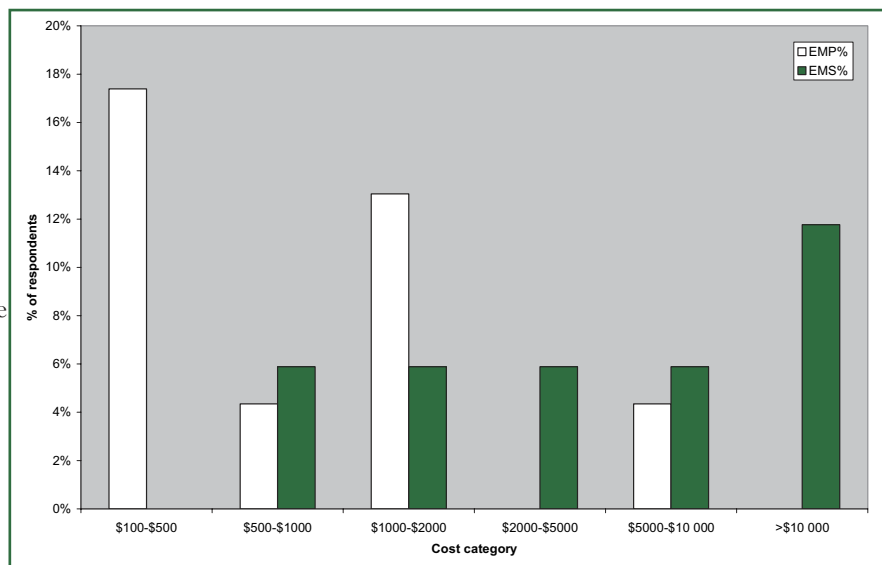


Figure 51 Costs of training

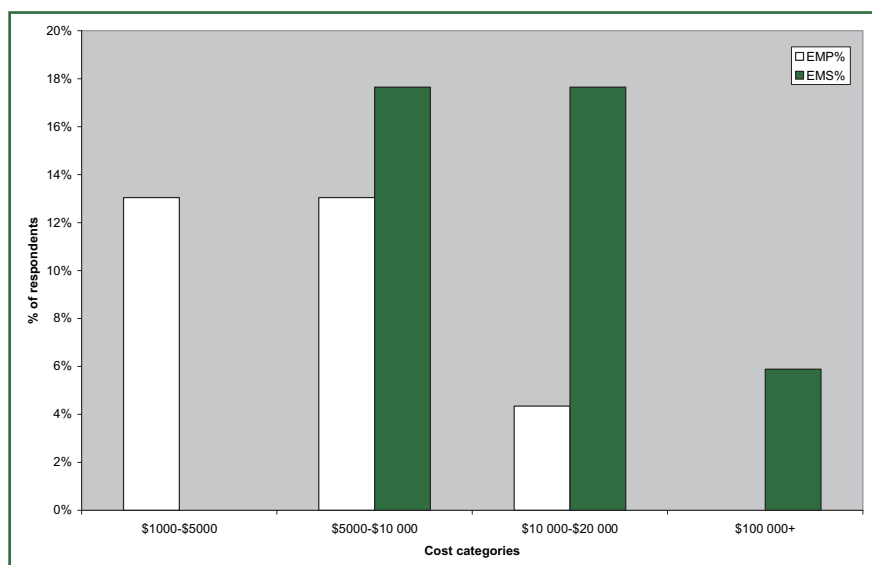


Figure 52 Costs of consultants

Consultancy

Approximately one-third of the EMP farmers reporting expenditure in this area were able to provide estimates of consultancy costs (Figure 52). Such costs ranged from \$1 000 to \$10 000. For EMS farmers, around half provided such estimates, with the majority of costs ranging from \$5 000 to \$20 000. A single EMS farmer reported consultancy costs of over \$100 000 but noted that these costs related to the whole-site redevelopment and included production-related advice in addition to environmental services.

Two of the EMP farmers and three of the EMS farmers used consultants to provide production information or information on cultural practices for their particular enterprises. One farmer within the EMS group had combined with other non-EMS farmers in his district to employ an agronomist between them, sharing the costs.

A further three EMP farmers did not specify what consultancy services they used, simply noting some annual expenditure for consultants. The EMP farmers reported the use of consultants in provision of quality assurance, integrated pest management and customer specifications information.

Two of the EMS farmers employed consultants specifically to assist with their EMS development, with single farmers in this group reporting the use of consultants to assist with general environmental management, integrated pest management, biodiversity audits and EMS audits.

As some of the EMS farmers were reporting environmental consultancy costs, in addition to those related to either production and/or quality management approaches, it is to be expected that their overall costs for consultants were higher. As shown in Figure 11, this group reported using a higher level of consultancy and EMS auditing services. Although the study did not examine the effects of removing consultancy costs specific to the EMS development from consultancy costs reported overall, it is likely that without this additional area of expenditure, consultancy costs for the two groups would have been similar.

Infrastructure

Of the farmers reporting infrastructure expenditure, approximately half of each group provided estimates. Infrastructure costs ranged from less than \$100 to more than \$2 million. The higher categories of expenditure (>\$100 000) in both groups related to

redevelopment of the farm infrastructure, and were not specific to environmental issues. Costs here also seemed to reflect the particular industry the farmer was engaged in and the level of mandatory environmental controls and monitoring required. If these ‘redevelopment’ areas of expenditure are not considered, then the EMS group appears to generally have had lower levels of spending in infrastructure that the EMP group.

Figure 53 shows the breakdown of costs on infrastructure, with five of the eight EMS farmers and six of the 13 EMP farmers who answered reporting infrastructure expenditure of \$50 000 or less. Again, this study does not support claims that EMS implementation will always result in higher levels of expenditure; however, the small sample size makes it difficult to provide a definitive answer on this point.

The EMP farmers reported spending on pipes, irrigation, dams, tractors and other equipment more frequently than EMS farmers (Figure 54). Again, this may be related to the enterprise they were involved in. Two farmers in each group reported spending on chemical and/or fuel stores (possibly related to ensuring legal compliance issues for chemical storage had been addressed). Each group also had single instances of specific items of infrastructure.

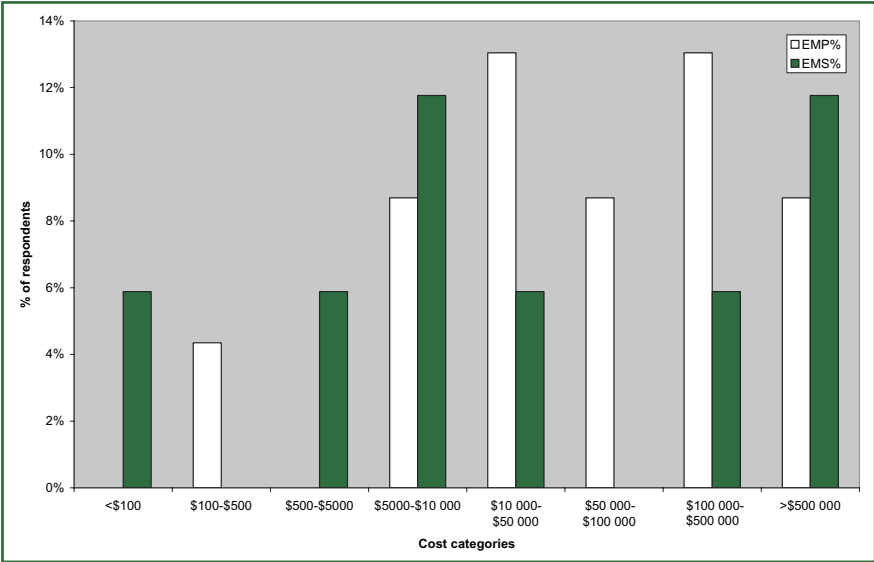


Figure 53 Costs of infrastructure and equipment

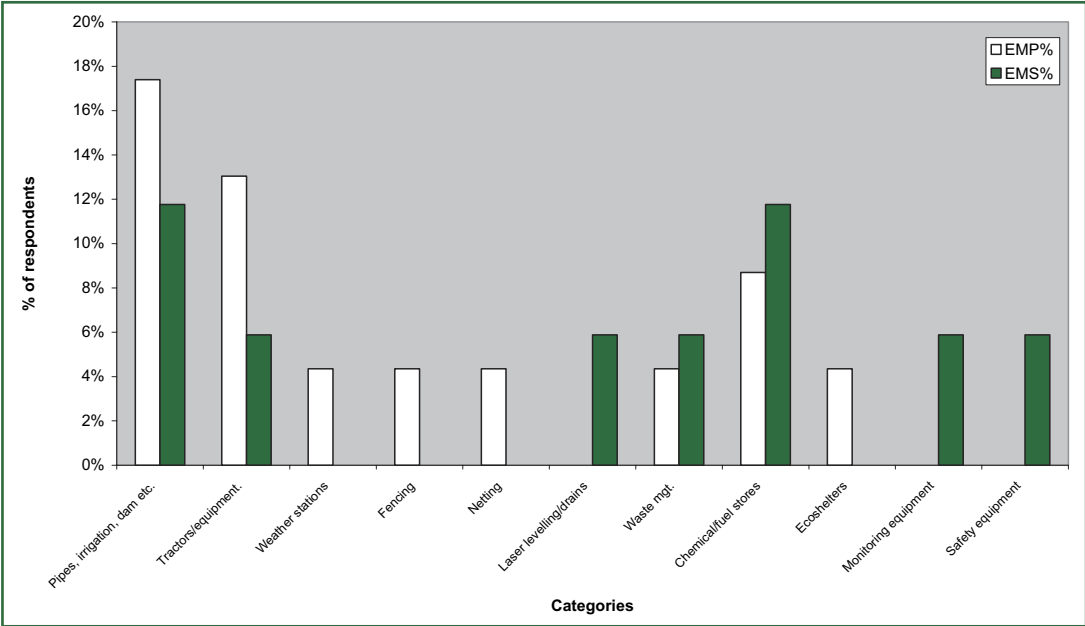


Figure 54 Items reported as infrastructure expenditure

Staffing

Four EMP and five EMS farmers reported hiring new staff. For the EMP group, two farmers had hired farmhands and, in one instance, the farmhand was able to contribute specific knowledge of the UK Natures Choice program. Single farmers in this group also reported hiring agronomists, and hiring out current staff who acted as consultants to other farmers in addition to their on-farm roles. In the EMS group, two farmers did not specify the roles of new staff; one employed a person to do environmental monitoring and another specifically employed staff to do only environmental work on-farm.

Adding or retaining jobs as a result of undertaking environmental initiatives has been reported in other business sectors (Florida and Davison 2001), where over 50% of EMS/pollution prevention plants reported adding or retaining staff, compared with only 26% of other businesses in the same industry. However, there are no clear indications in the current study that implementing an EMS means that new staff will be needed. The somewhat greater use of consultants by the EMS group may be supplying any needs for additional skills or information. In a farming context, it would be difficult to foresee an on-going demand for additional staff levels on-farm, once an EMS was established and operating, except perhaps in areas such as auditing and provision of technical advice. Given the small business structure of farms, it would seem far more cost-effective to 'buy in' these skills as needed, rather than employing full-time staff. However, in the community context, it is possible that sharing such skills between groups of farmers would be viable, as was observed with collective hiring of agronomists and similar advisers.

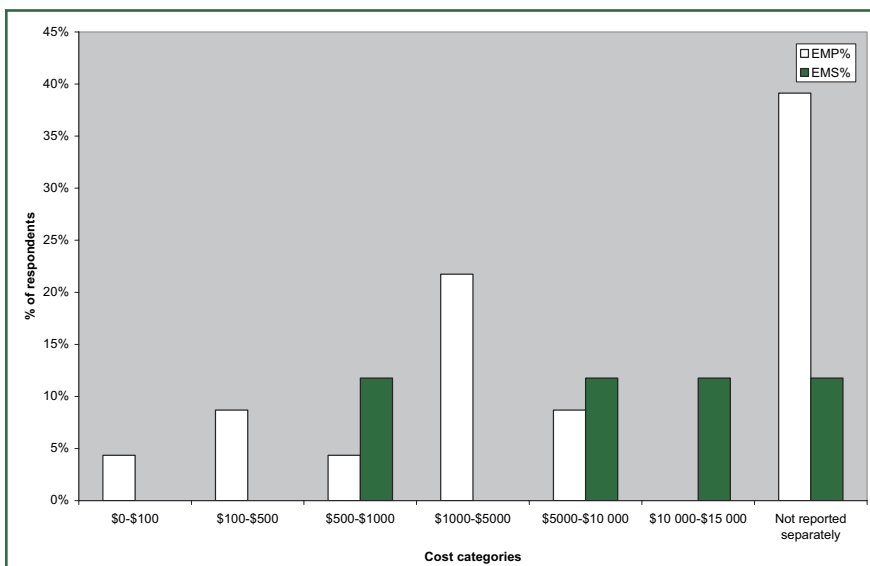


Figure 55 Annual monitoring costs

Monitoring

Approximately 50% of both groups provided annual monitoring costs. Monitoring costs reported by EMP farmers ranged from zero to \$10 000 (Figure 55). However, approximately 40% of this group stated that they did not separate monitoring costs from other areas of expenditure, despite 60% reporting this as an area of expenditure. For the EMS group, two farmers did not separate monitoring costs from other costs. Two EMS farmers each reported monitoring costs of \$500 – \$1 000, \$5 000 – \$10 000 and \$10 000 – \$15 000 annually.

Higher monitoring costs in both groups were usually associated with intensive livestock production or aquaculture, and related to meeting licence conditions for effluent discharges and stock health. The EMS group did report monitoring costs at the higher levels but, due to low numbers in the sample, it is difficult to assess whether this is a consequence of using an EMS, is industry related,

or whether these farmers already spent more on monitoring to begin with. Comments from EMS farmers did suggest that monitoring was more targeted than it had been, and potentially this could assist in saving monitoring costs.

Administration

Four farmers in each group reported on annual administration costs (Figure 56). Typical items were salaries for staff or the farmers performing administrative roles, stationery and office costs. Two individuals in the EMP group reported costs of \$100 – \$500 and \$1 000 – \$5 000 annually. Two EMS farmers reported administration costs of \$1 000 – \$5 000 annually, with one farmer reporting costs of \$100 – \$500, and another reporting costs of \$500 – \$1 000. The small number of farmers reporting administration costs precludes any conclusions being drawn regarding annual costs. One of the EMS farmers suggested that a group of farmers hiring an administrative assistant between them would be helpful for running farms, irrespective of EMS status.

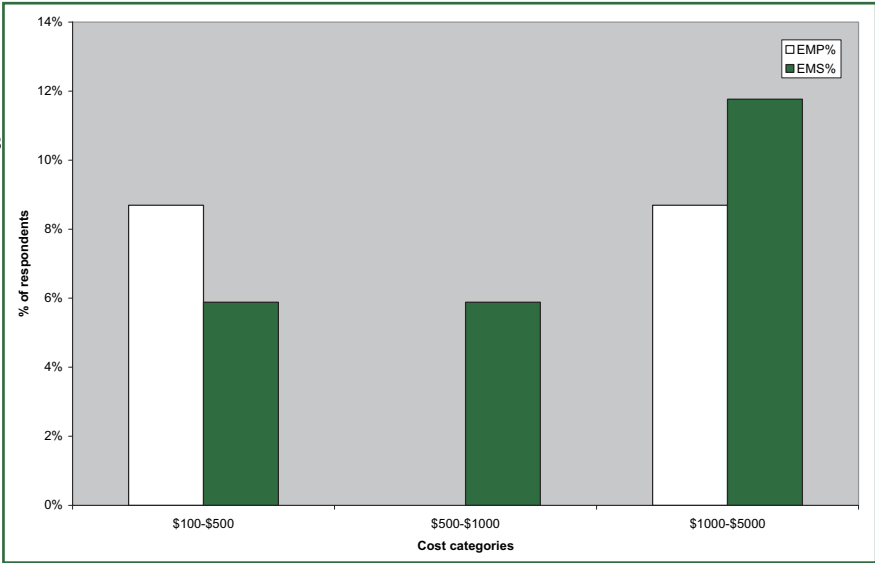


Figure 56 Annual administration costs

It is significant that the EMS did not report higher expenditure in this area than the EMP group, as one of the barriers to EMS implementation is the perceived higher level of ‘office’ work required. This study would tend to suggest that administration is an area where farmers do not readily attribute costs, and thus probably do not have a clear understanding of their expenditure and effort.

Software

Software was a component of administration examined. Again, relatively few farmers in either group reported software costs (Figure 57). Three EMP farmers had spent \$1 000 – \$ 2 000 on software, with a fourth spending \$5 000 – \$10 000. Single farmers in the EMS group reported software expenditures, one in each of the cost categories. No differences are apparent between the two groups with respect to software purchases or expenditure. There was, however,

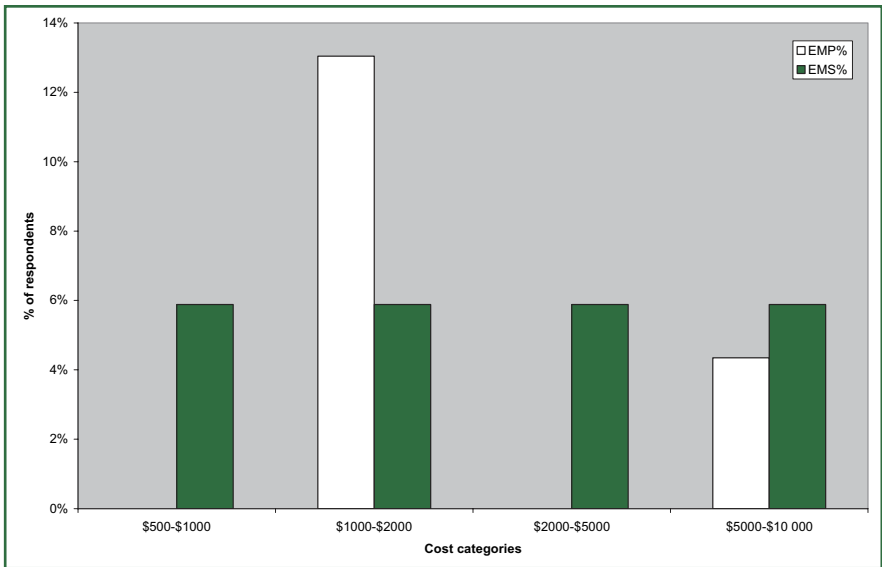


Figure 57 Software costs

some indication that software purchases were related to the industry sector, with more purchases occurring in the intensive-industry farms.

No farmer reported specific environmental software purchases. Of the four in each group reporting software purchases, programs purchased dealt with mapping or general business and office applications, and includes programs such as PinPoint, Paddock Action Manager (PAM) and Farmtracker. Financial programs also included Goods and Service Tax/Business Activity Statement programs. However, at the time of the study, there was no EMS software specific to agricultural enterprises, and packages available for other industry sectors were not suitable for farm application.

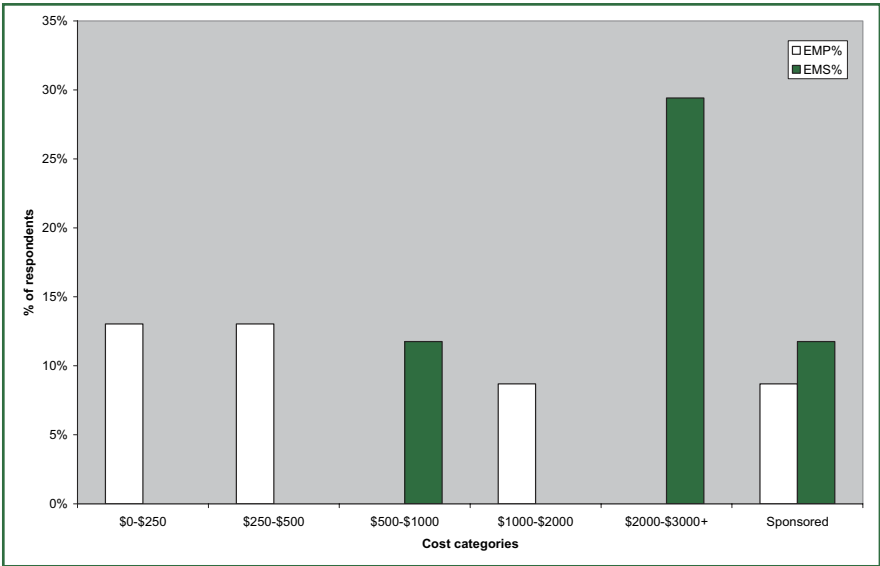


Figure 58 Annual auditing costs

Auditing

The EMS group reported spending more on audits than the EMP group (Figure 58). Approximately 30% of the EMS group reported spending \$2 000 – \$3 000 on auditing in the previous year, and two farmers reported \$500 – \$1 000. Six of the EMP group reported spending up to \$500 annually on audits, with two spending \$1 000 – \$2 000 annually.

Despite both groups having similar numbers of farmers reporting expenditure on auditing, the EMS group reporting undertaking a slightly wider range of audits than the EMP

group (Figure 59). Two farmers in each group also reported that the costs of their audits had been initially sponsored, by the Tesco’s Natures Choice/Field Fresh program for the EMP farmers and in New Zealand by the North Otago Sustainable Land Management group (a local council/community group collaborative program) for the EMS farmers. The EMS farmers reported Graincare, HACCP, Woolworths Vendor Quality Management Scheme, ISO 14001, and ISO 9000 audits, whereas the EMP group reported CATTLECARE, Natures Choice, and biodynamic/organic audits. Both groups also had two farmers undertaking SQF 2000 audits.

Therefore, the higher level of expenditure reported by the EMS group may be due to the fact that they were undertaking more audits (both environmental and quality in some cases), whereas the EMP group were only undertaking quality audits. In addition, some EMS farmers were undertaking both QA and EMS audits, whereas the EMP group, if being audited, were often only being audited under one approach.

Farmers in both groups frequently expressed frustration with the need to have multiple audits to meet customer demands, and many stated that integrated quality,

environmental and OH and S audits would be preferred. EMS farmers stated their frustration at the lack of recognition granted to their EMS by auditors of other programs, in particular the refusal by these auditors to recognise records when they were not on the mandated proforma sheets for each program. This occurred even if the same records were being considered (for example, spray records to meet both livestock and grain QA programs had to be provided on separate forms, even though they were exactly the same data). Integration, both of auditing procedures and auditor training, was seen as essential to facilitate uptake of auditing on-farm.

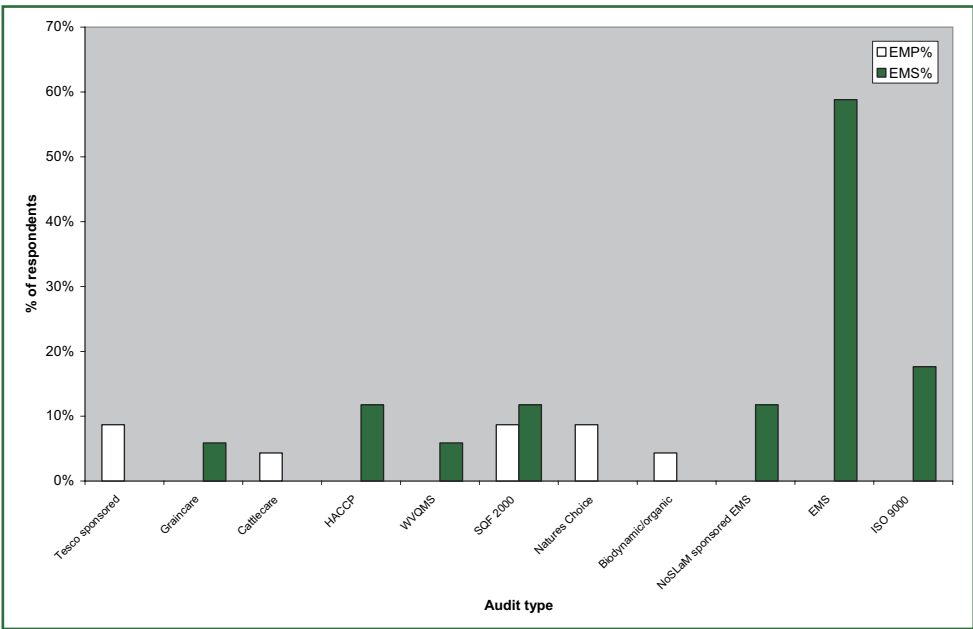


Figure 59 Audits undertaken

The lack of integrated auditing processes emerged as a concern for many farmers. EMS farmers often stated they got more value from their EMS than their QA audits (in terms of feedback from the auditors) but were forced to also undertake specific QA audits in many cases to meet customer demand for food safety/quality issues. Farmers in both groups expressed a desire for auditing processes that were common across all enterprise sectors. Such audits would need to be robust enough to meet the range of stakeholder needs, ranging from customers through to community and catchment groups, in the case of environmental performance audits, yet still be flexible enough for the range of enterprises and regions that would be involved. A small number of farmers in the EMS group reported that they were undertaking combined QA, EMS and OH and S audits, but auditors able to provide such auditing services were rare. In these cases, audit costs obviously were reduced somewhat when compared with separate audits for the different management areas.

The results of this study suggest that the EMS group were paying for additional auditing services, over and above those being used by the EMP group. This, and the higher charges for systems audits compared with other audits, account for the higher overall expenditure on auditing by this group.

The costs proposed for farm implementation of EMS by some researchers in Australia often appear to be higher than have been observed in comparably sized secondary industry businesses (Edward et al. 2002). Experience with Australian grain farmers showed that for single-operator farms working in collaboration with government

researchers, costs for EMS development were under \$2 000 per year (Carruthers and Tinning 2002 unpublished), with total costs in the first year of undertaking a certification audit approximately \$5 000. Subsequent auditing costs were approximately \$1 500 per year. Therefore, the suggestions that for a farm to develop and implement an EMS will cost tens if not hundreds of thousands of dollars seem exaggerated in the extreme. One of the difficulties in estimating costs for EMS development is the lack of knowledge regarding the baseline management approaches already in place on-farm. Costs are very strongly linked to what is already in place, and if a farmer is already operating at a high level of business management and compliance, costs to implement an EMS are often minimal.

In summary, farmers using an EMS appeared to incur higher costs related to training, consultancy services and auditing, usually specific to EMS implementation. EMS farmers more commonly reported specific areas of costs than did EMP farmers. It may be that the EMS farmers were able to do so either due to specifically monitoring costs, or to more detailed record-keeping. Therefore, it is possible that the EMP group may have been underestimating or not recognising some costs.

In some cases, EMS farmers used their investment to generate further income, through application of the skills learnt through training to work as consultants for other farmers, or to develop new opportunities for off-farm income (such as the construction of safe chemical storages for other farmers). In this way, they were able to off-set some of the expenditure on environmental issues.

Finally, those farmers using ISO 14001 as well as systematic QA approaches (for example, ISO 9000-based systems), were sometimes able to share costs between their QA and EMS implementation and auditing. The ability to integrate management approaches is vital for cost-effective management, and the chief discontent with some of the non-systems QA approaches was the lack of recognition of areas of commonality. It is theoretically easy to address such issues to provide a streamlined auditing and certification approach, if management and auditing are based on common management principles, rather than narrowly defined performance-based outcomes only (which are frequently assessed by a 'checklist approach', rather than an audit).

Costs in time

Changes had been made by 34% of the EMP group in one to five years. By 10 years, 52% had made their changes and 17% said that their changes had taken place over a period greater than ten years. In the EMS group, 41% reported making changes over two years or less. This figure had increased to 65% by five years, and 88% by 10 years. The majority of EMS farmers reported making changes over a shorter period of time than EMP farmers, with one making changes to management in less than one year (Figure 60). Around 30% of the EMP group and 18% of the EMS group indicated that they felt change was an on-going process.

Again, the two groups used a slightly different context when answering this question, with the EMS group referring specifically to changes made with regard to the EMS.

In most secondary industry sectors, EMS implementation usually occurs in an 18-month to two-year timeframe. Thus, the time taken to develop and implement EMS by farmers in this study is in accord with that reported in other industry sectors.

Social

One area of cost commented upon more frequently, but not exclusively by the EMS group was the suspicion and, in some cases, hostility they had encountered from their peers when adopting changed practices. Some EMS farmers reported that their peers believed that, by adopting an EMS, they were somehow undermining the reputations of farmers not following such an approach. This created problems within the local community or industry group, and appeared to be a significant factor in the lack of desire by some EMS farmers to promote what they had done on their farms. Such negative peer pressure particularly impacted upon farmers who were more extrinsically motivated, rather than those who were acting on a personal conviction (intrinsically motivated), as peer support would be more important to farmers who wanted industry or community acceptance. Feelings of isolation and of 'being ahead of the pack' were frequently expressed by the EMS group, sometimes as a source of pride (at being innovative and in front), but frequently as a distressing factor influencing their ability to gain support and information about management actions they were taking. It is likely that groups such as Landcare could have an important role in providing support for farmers undertaking EMS, but only if the facilitators or other group members have an active and sympathetic understanding of what an EMS is and tries to achieve.

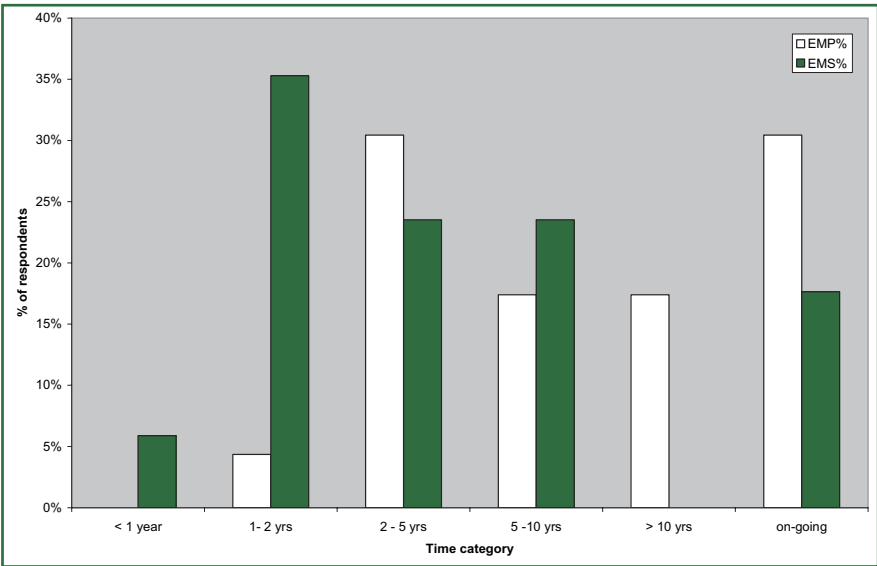


Figure 60 Time taken to make changes

Effect of management changes on assessing costs

When asked if the changes they had made on-farm meant it was easier to assess costs overall, 74% of the EMP farmers and 53% of EMS farmers said this was the case, with 65% of the EMP farmers and 18% of the EMS farmers stating that it was easier to assess costs due to better records. Three farmers in each group said that it was too difficult to make this judgement at present. Friedman and Miles (2001) reported that many SMEs frequently do not have quantified financial or environmental savings from adopting changed practices although they plan to do so in the future. The results of the current study therefore do not reflect the situation described by Friedman and Miles (2001) in that a substantial proportion of both groups believed that they could estimate costs associated with making changes.

Cary et al. (2002) reported that landholders’ perceptions of their future financial situation was more commonly associated with their adoption of changed practices than with measurement of indicators related to their current financial position. Therefore, despite the fact that not all farmers directly measured financial outcomes, the adoption of changed practices may have led the farmers to be more confident, and thus more likely to report that costs were easier to assess. The reported increase in record-keeping by EMP farmers may link here – they saw increased recording as a changed practice and were thus possibly more likely to report ease of keeping track of costs.

This result was somewhat unexpected, as the EMS group might reasonably have been expected to have established a range of indicators, including financial measures, by which to assess the outcomes of targets set within the EMS. This group had a higher average number of indicators routinely in use. However, without a baseline of records already kept, it is impossible to know whether this parameter changed for either group over time, or whether different perceptions were influencing reporting.

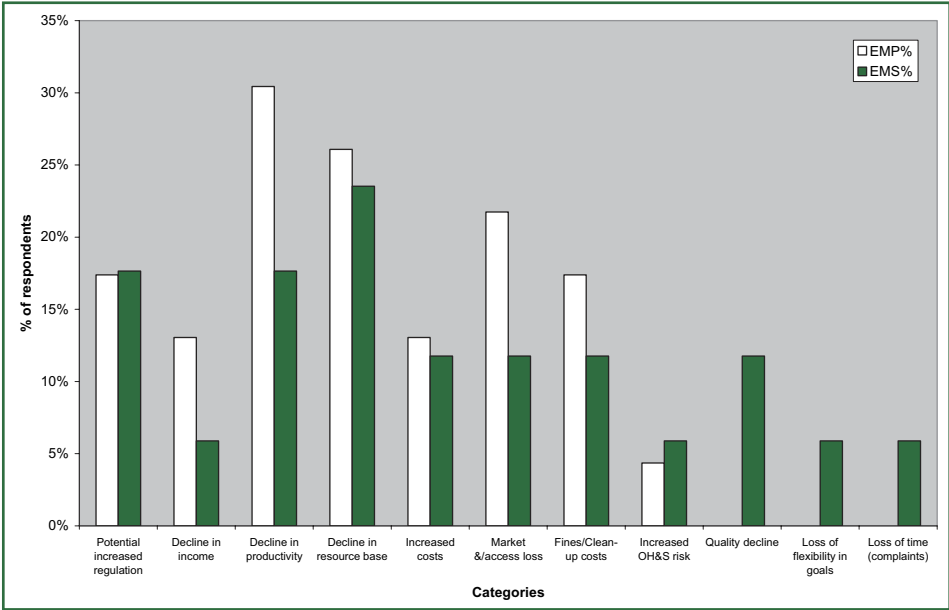


Figure 61 Potential costs if no changes made

Potential costs of not changing practices

Farmers were also asked to identify potential costs that might have occurred if changes had not been made. Rather than expressing these in dollar terms, farmers identified potential risks. These are shown in Figure 61. Of the eight potential risks identified by the EMP group, decline in productivity was most commonly identified, by approximately 30% of farmers. A decline in the resource base was next (approximately 25%), followed by potential loss of markets or market access and potential

for increased regulations and or/fines. Decline in income, increased costs (both by two farmers) and increased OH and S risks were also identified by some in the EMP group.

A decline in the resource base was the most frequently nominated area by the EMS group, followed equally by the potential for increased regulation and decline in farm productivity. This group also exclusively identified three other areas of risk; two farmers nominated quality decline, and single farmers named a loss of flexibility in goal setting (due to increasing regulations being imposed and/or loss of potential diversification in the future) and loss of time in dealing with complaints. Two farmers nominated increased financial costs, and single farmers nominated decline in income and increased OH & S risks.

Less than 20% of either group saw increased regulation as a risk of not taking action. This relates back to initial motivations, with neither group predominantly motivated to make changes due to regulatory factors. Overall, a greater proportion of the EMP group nominated potential risks associated with not making changes (except for the ‘increased legislation’ and ‘OH and S’ risk categories). This may have been because the EMS group had already been through a risk assessment exercise, had a better understanding of their risk profile, and thus believed they had measures in place to address such risks.

Disadvantages of making changes

Finally, farmers were asked to identify disadvantages other than monetary associated with the changes they had made (Figure 62). A significant proportion of both groups (EMP 39% and EMS 53%) said there were no disadvantages but around 25% of each group stated that more time was needed in the office. EMP farmers identified 10 areas of disadvantage (with eight of these nominated by one farmer only). Six areas of disadvantage were identified by single EMS farmers. Two EMP farmers suggested there was increased risk due to inexperienced staff. The ‘paperwork’ barrier often discussed with regard to EMS adoption was not more commonly raised as an issue by the EMS group and so perhaps is more a perception than a reality. Again, with no information about the level of paperwork and office time spent by farmers in either group prior to their implementing changes on-farm, it is impossible to say what, if any, effect management changes had.

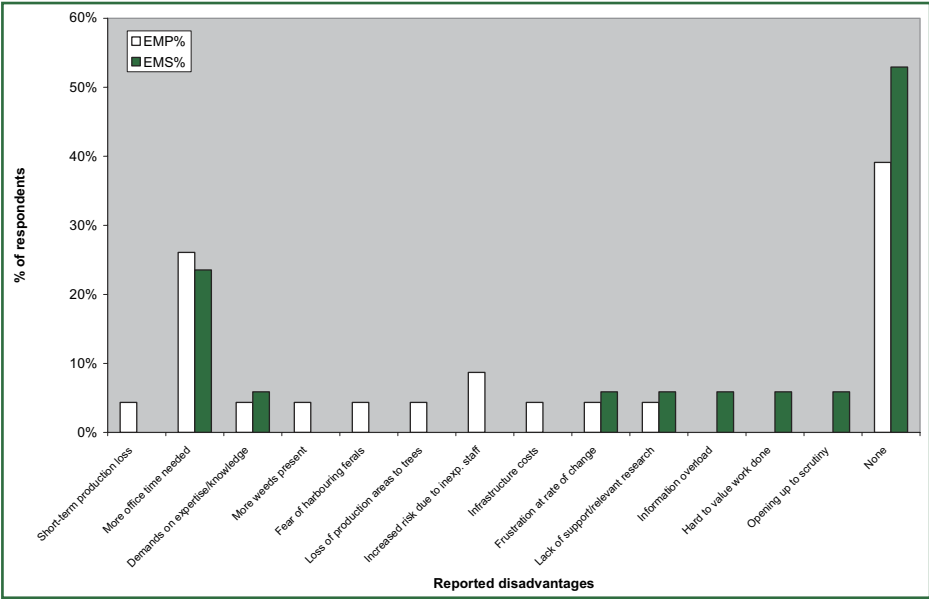


Figure 62 Disadvantages (not monetary) of changes

3.17 Integration of management approaches

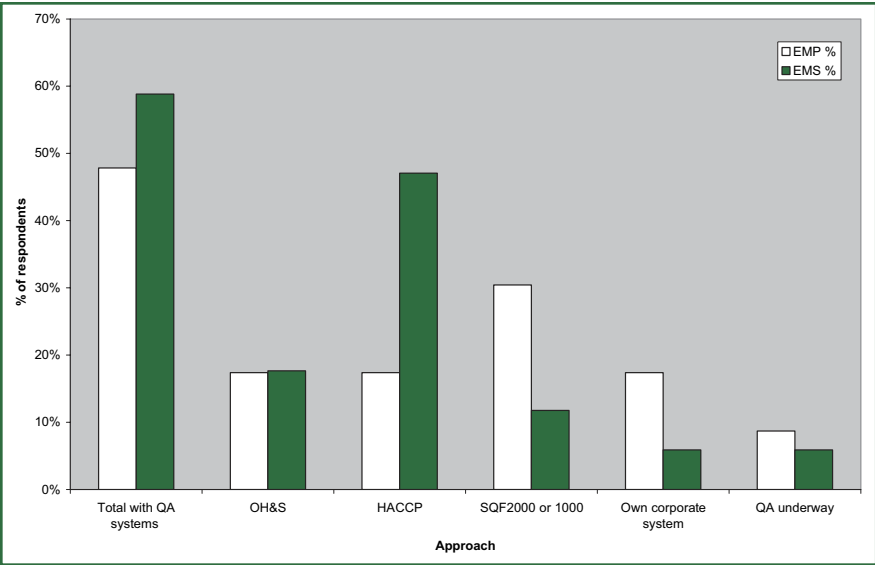


Figure 63 Other management approaches in place – general categories

a wider range of management approaches or certification/accreditation schemes (15 categories), while 9 different approaches were used by EMP farmers. This finding is similar to that of Florida and Davison (2001) and Andrews et al. (2001, 2002), who claimed that innovative businesses are more likely to be innovative over a range of dimensions. They also claimed that innovative business were up to 17 times more likely to adopt more advanced management practices, such as employee involvement, internal auditing, supplier audits, ISO 9000, total quality management and ‘just in

time’ practices, than less advanced businesses. As the farmers chosen for these case studies were recommended to researchers as being at the cutting edge of environmental management on-farm, it is not surprising to find that they were utilising a range of innovative management approaches. Innovations were evident, not only in the various management approaches being used (such as minimum

Many of the farmers interviewed also had other management programs in place. Figure 63 shows the general categories of their programs. Approximately 50% of the EMP and 60% of the EMS group had some form of QA program operating. OH and S and food safety management programs were also in place on a number of farms.

The various approaches to QA have been grouped in Figure 64 and include a variety of ‘care’ programs (CATTLECARE, Flockcare, and Graincare etc.), ISO 9000, and others. The EMS farmers reported

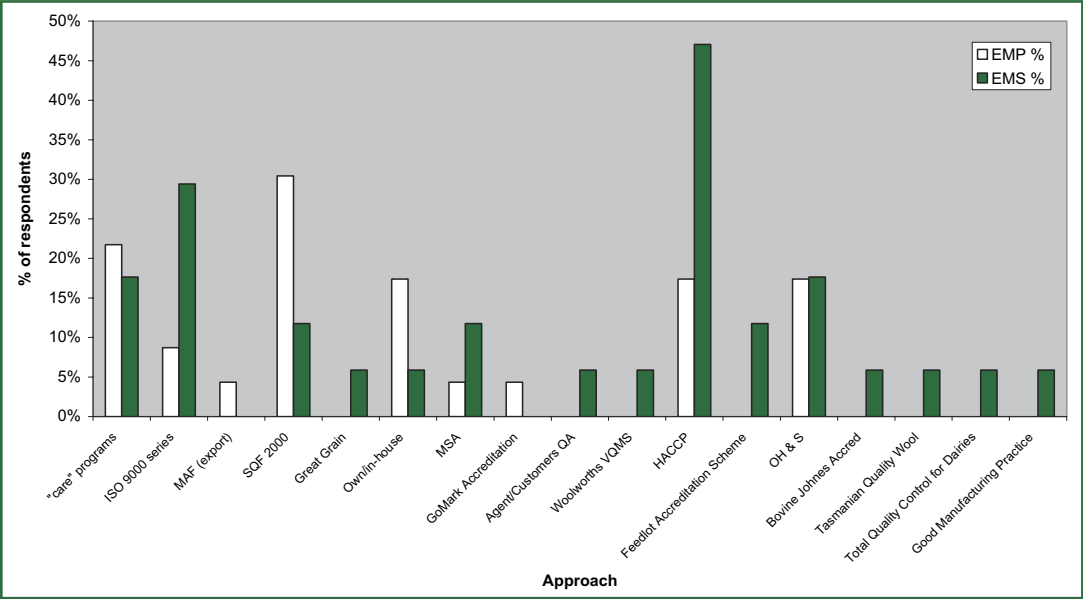


Figure 64 Other management approaches in place – specific categories

time’ practices, than less advanced businesses. As the farmers chosen for these case studies were recommended to researchers as being at the cutting edge of environmental management on-farm, it is not surprising to find that they were utilising a range of innovative management approaches. Innovations were evident, not only in the various management approaches being used (such as minimum

tillage and advance chemical application technologies) but also in attitudes to resource management in general and environmental management in particular.

What management programs were being used?

The type of QA program used appeared to be related to the use of ISO 14001, as more of the EMS farmers had QA systems based on the ISO 9000 series of Standards (29% of EMS group, but only 9% of the EMP group). The result is similar to that noted by Corbett and Kirsch (2001) for industrial EMS applications, where ISO 9000 and 14001 systems were often linked.

The EMP group was more likely to use one of the various “care” programs such as CATTLECARE or Flockcare (22% of the EMP and 18% of the EMS group), industry- or business-specific approaches, and SQF 2000. However, since some EMS farmers also used some of these programs, the use of related management approaches is not clear-cut, and may be related to market demands. Industry sector relationships were also noted, with feedlots operating feedlot accreditation schemes, essential oil producers involved with Therapeutic Goods Administration Good Manufacturing Practices, and wool producers utilising specific wool QA programs.

More of the EMS farmers reported using Hazard Analysis and Critical Control Point (HACCP) programs (47% versus only 17% of the EMP group). HACCP shares many of the elements common to ‘systems’ management, and so would integrate well with both ISO 9000 and 14001-based management approaches.

Approximately 17% of farmers in both groups were applying OH and S programs. As this study was undertaken before the development of a national OH and S standard, the degree to which the OH and S programs deployed within the farm businesses might address this standard is unknown. However, the Australian OH and S Standard has been written in such a way as to share common elements with both ISO 14001 and ISO 9000, so integration between all three approaches is facilitated.

The adoption of EMS and EMP was sometimes an extension of an existing QA program, or arose through a frustration at having multiple QA programs, driving practitioners to seek an integrated management approach. The effectiveness of ISO 14001 as an overall management tool that enabled the integration of QA, OH & S, financial and productivity areas was raised by many of the farmers using a formal EMS approach. This ‘integrative potential’ was seen by many as an attractive feature of the EMS process approach. Corbett and Kirsch (2001) also observed this linkage between formal QA approaches (such as the ISO 9000 series) and EMS in their examination of the international diffusion of ISO 14001. They suggested that, in many cases, much of the work in collecting relevant information and business organisation had been completed in the development of the quality programs, with much less work required for implementation of ISO 14001. Weeks (2003) reported that Western Australian grain farmers had designed their EMSs to integrate with existing QA practices (‘providing it was relevant’). This takes into account the existing QA work and adds value overall. In

the case of the Western Australian farmers, areas of overlap identified included pesticide use, affecting both food safety and environmental matters, and were included in both QA and EMS work.

Several EMS farmers also stated that they had been working on quality systems with a consultant who suggested there may be many advantages to adopting an integrated approach and introduced them to the concept of EMS. Large South African wineries surveyed (Knowles and Hill 2001) all had ISO 9002 QA systems in place due to market pressure, and knowledge of ISO 14001 was linked with QA implementation.

Approximately 70% of the EMP and 95% of the EMS farmers indicated that quality, environmental and other management systems should be integrated. As previously indicated, 41% of the EMS farmers stated that their management goals had shifted to include more integration of management systems since commencing EMS use. However, 17% of the EMP farmers did not feel that environmental and other management systems should be integrated.

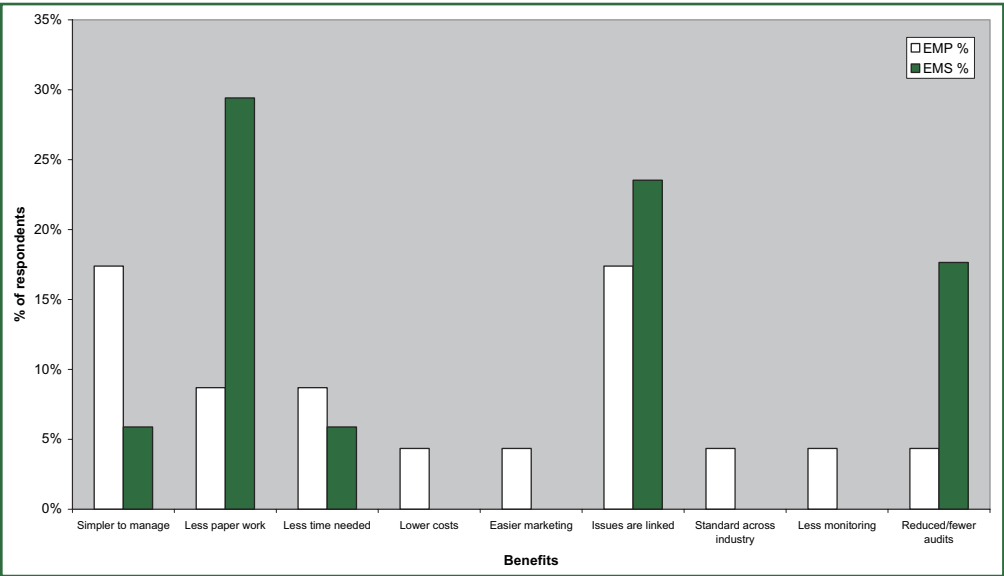


Figure 65 Perceived benefits of integrated systems

Benefits of integration

The perceived benefits of integrating management approaches, as reported by the two groups, are shown in Figure 65. More participants answered this question than the following one on disadvantages of integration. The EMP group identified more benefits of integration (nine) than the EMS group (five); however, five of the advantages of integration were only raised by single EMP farmers.

The EMP farmers rated simplicity of use and the linkage of issues as the major benefits (17%). Linkage of issues was also a feature for the EMS farmers (24%); however, they rated the reduction in paper work as the most attractive feature of integration (29%). Two of the EMP farmers agreed this might be a benefit of integration. The EMS group also mentioned the potential for reduction of audits (18%) but only a single EMP farmer suggested this category. It is possible that experience gained through a systems approach allowed the EMS farmers to recognise the ability to integrate management approaches using common systems elements and auditing procedures, whereas the EMP participants had not had the opportunity to experience such integration potential. There

was recognition that integration would take work – only two EMP farmers and one EMS farmer suggested that less time required would be a benefit of integration.

These results may indicate that the EMS farmers had already developed an integrative approach to management, possibly enhanced or heightened by the practice of using a management process approach. As the ISO-based management approaches have numerous elements in common, integration is facilitated. An integrated approach to management (covering environmental, health, and safety issues) in an EMS offers the greatest advantages in flexibility, customisation and provides the optimum circumstances to enhance a culture of continuous improvement (Tinsley 2002).

Some EMS farmers expressed their frustration at various industry-specific QA programs which focused only on specific industry-related issues, ignoring commonalities across enterprises, and which did not consider ‘management’ overall. A checklist approach to development of what issues needed to be addressed, with a related ‘tick the box’ audit was felt to be very restrictive and did not allow individuals to customise management practices specific to their individual needs. By using a risk-based approach (such as used in ISO 14001), the EMS farmers found that they could give priority to particular issues according to their own situations, with auditors (if used) able to assess how well the management system met the requirements of the user, not simply showing that pre-determined issues (set by off-farm industry players) had been covered.

It is also interesting to note that reductions in paperwork and auditing were cited by EMS farmers as benefits of integration, as paperwork and auditing are frequently cited as barriers to EMS adoption. Perhaps, experience gained from actually using an EMS better informs the operators of just how such systems can be used, giving a more realistic understanding than that gained from a theoretical perspective. The reduction in the number of audits through integration was another area well regarded by EMS users.

Drawbacks of integration

The two groups identified fewer drawbacks than benefits of integration of management systems, with only three individual categories nominated by single farmers in the EMS group (more time/concentration needed, confusion of focus, and audit costs). EMP farmers identified 7 categories of concern but of those, four were identified by single farmers only (Figure 66). For the EMP farmers, the greatest concern (identified by three farmers) was a perceived need for additional documentation. This was contrary to the EMS group, who claimed that integration actually reduced paperwork.

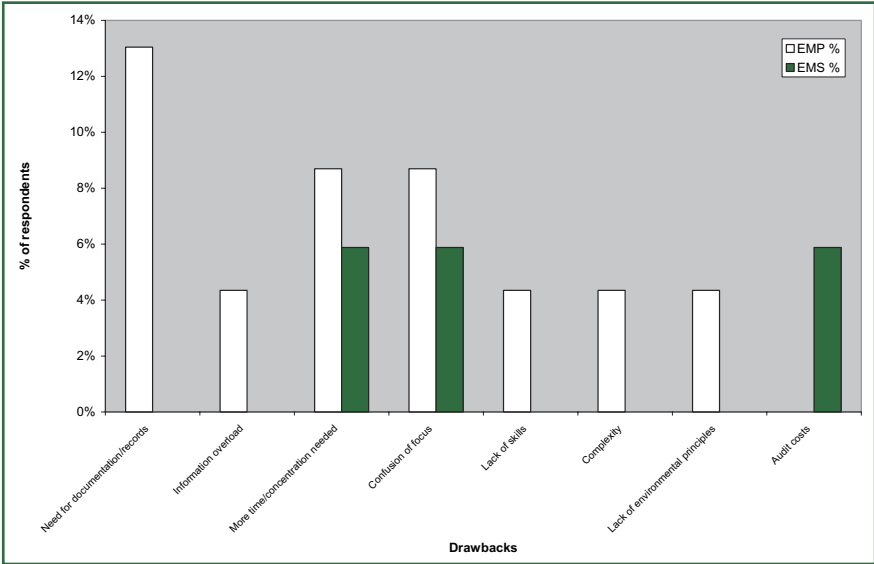


Figure 66 Perceived drawbacks of integrating systems

The two groups apparently had a different perception of the need for paper work, as the EMS group did not feel that covering additional areas of management in an integrated system would automatically require extra paperwork. Perhaps this difference is due to the use of a system approach by the EMS group (allowing flexibility in issues but more formality in the management process). Using a process allows easy integration of issues, whereas following an approach that prescribes outcomes (such as that found in a range of BMPs and QA programs) means that there is a loss of flexibility and, in some cases, a necessity to use prescribed proformas and documentation. It could also be that the EMS group had worked through issues surrounding paperwork as part of the EMS process itself, and so the ‘paperwork fear’ had been addressed.

Overall, both groups identified more benefits than drawbacks associated with integration of management into a streamlined approach, with a high level of support for taking an integrated approach, not only to management, but also to auditing and documentation.

3.18 Assistance desired by farmers

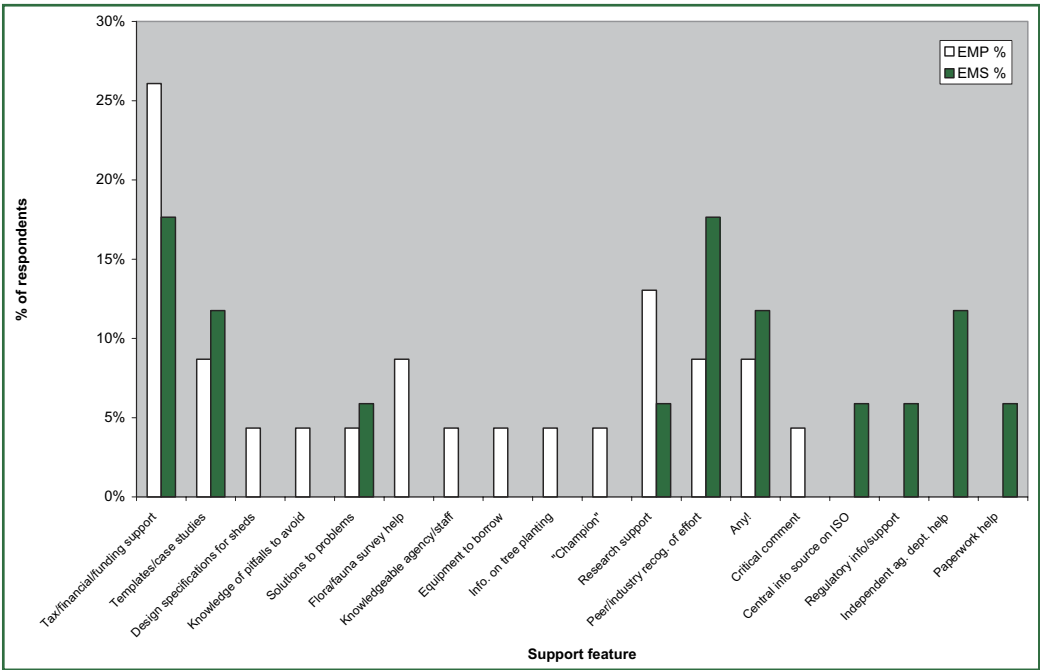


Figure 67 What support would farmers have liked when making changes?

What support would have helped in making changes?

Williams et al. (2000) claimed that over two-thirds of the SMEs they surveyed in Western Australia would consider using an EMS tailored to their specific needs. However, these systems had to be simple, inexpensive, low maintenance, consist of minimal paperwork, and not take time away

from production. In the case of agricultural EMS development, a range of support mechanisms are likely to be needed in order to achieve such a ‘wish-list’. Farmers in the current study were asked what support they would have liked to receive when making changes on their farms. Responses to this question are shown in Figure 67. The EMP groups nominated 14 sources of support (with 8 exclusive categories), while the EMS group nominated 10 (4 exclusively). Again, many of the issues were raised by only one or two individuals.

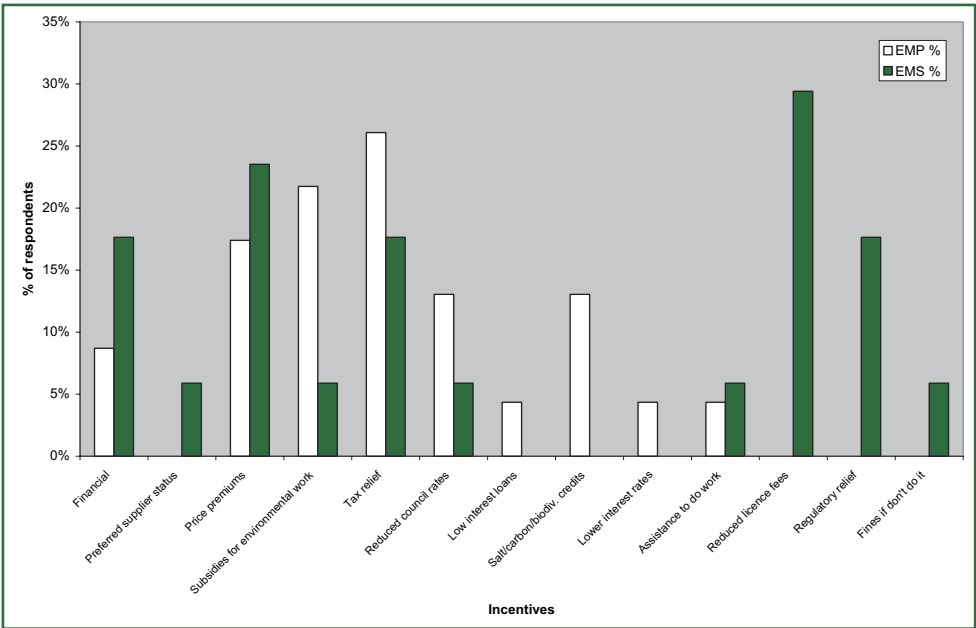
For the EMP group, the most frequently nominated form of support desired (26%) was funding (whether through taxation relief, financial support or similar). Research and provision of information (through a variety of formats) were also raised by this group, but by only three individuals. Eight areas were nominated by single farmers, often relating to specific information in technical areas or feedback on work done.

For the EMS group, financial and peer/industry support were equally commonly nominated forms of assistance desired (18%). The desire for peer and industry support may relate back to initial motivations of public opinion/pressure for change, and may reflect a need for feedback that these motivations had been addressed. Provision of information in various forms was seen as desirable by this group: requests for templates and case studies, research support, centralised and independent sources of information were all suggested by small numbers of individuals.

Reflecting the feeling held by many farmers in the study that they were ‘ahead of the pack’, several farmers in both groups suggested that ‘any’ support at all would have been welcomed.

What sort of incentives were individuals seeking for themselves?

Farmers were asked what sort of incentives might have made them change their practices. There was strong support for financial incentives being provided to farmers who demonstrate that they are managing their farms in an environmentally responsible manner, with approximately 90% in both groups agreeing such incentives would work. It was suggested that such financial encouragement could come from markets (through premiums and/or assured supplier status) or from reductions in business costs (reduced land rates, taxes, low interest loans specifically for environmental works, or lower interest rates generally). The EMS group also raised three potential areas of regulatory incentives – reductions in licence fees, regulatory ‘relief’, and even the possibility suggested by one farmer, that fines could be imposed on people not demonstrating attempts at sustainable management.



As shown in Figure 68, tax relief was the most frequently nominated form for providing such incentives by the EMP group (26%), followed by subsidies for environmental

Figure 68 What incentives did individual farmers want for themselves when making

works (22%). Various 'credit' schemes (carbon/salt/biodiversity) and reduced council rates for land were also suggested. In addition, single farmers in this group suggested that low interest loan availability, lower interest rates and on-ground assistance would also serve as incentives.

The EMS group more commonly suggested reduced licence fees (29%) or price premiums (24%) as a means of providing encouragement to change practices. Financial incentives generally, tax relief and regulatory relief were the next three most commonly nominated forms. Again, the focus on the more regulatory areas by this group was of interest, as this group had fewer regulated enterprises and fewer businesses subject to licence fees. Perhaps this was suggested as an incentive because this group felt more confident about their ability to 'prove' eligibility for any such incentive payments. This result may also suggest that regulatory relief and surety regarding licensing could serve as incentives when used to encourage change, but not when used in a punitive manner.

The EMS group was also more likely to indicate that markets could supply incentives, with preferred supplier status and price premiums more often suggested to provide the financial incentives sought, rather than the EMP group who saw such incentives coming more from government sources (through reduced rates, taxes or subsidies).

Interestingly, there was not a demand for more information on specific performance parameters to be met through farm management. Mech (2002) suggested that increased development of best management practices or codes of practice relevant to specific industries and/or regions would be an appropriate form of support that government agencies could provide. EMS farmers in this study were slightly more likely to mention case studies or templates and 'solutions' to various environmental problems, but relatively few EMS farmers and fewer EMP farmers called for this sort of support. Indeed, many farmers indicated during interviews that they actually felt that there was too much information available for them, and that having some sort of 'filter' was useful. EMS farmers raised the risk assessment process as being the tool that allowed them to 'filter' information in some cases, suggesting that EMS may even assist in farmers adopting BMPs or similar.

A higher proportion of the EMS farmers reported using BMPs/COPs (82%) than EMP farmers (61%), with environmentally-related best management practices also more commonly used (79% of EMS farmers and 57% of EMP farmers). Using a more standard approach to identification of environmental issues that need to be addressed, may assist with the development of future best management practices, as issues of particular interest will be identified by the ultimate end-user (the farmers) rather than by researchers who may have an academic, but not practical, interest in a particular suite of issues (Carruthers and Tinning 2003). Close communication between governments, industry groups, researchers and farmers using EMS or other management approaches is more likely to yield the resource management information actually required by farmers, and an iterative process of using and evaluating such information likely to be most productive. Mech (2002) raised the need to improve and adapt such information over time, and again suggested this as a potential role for government.

Incentives for other farmers to change

Use of an EMS may provide the vehicle to achieve particular personal goals and influence environmental performance (Coglianese 2001), but incentives will need to be tailored to some extent to cater for the particular motivation(s) of the EMS user. For example, if a farmer wants to achieve public recognition for the environmental stewardship, then public acclaim, awards and possibly signage may meet this motivation. However, should a farmer be seeking improved financial performance as a prime target, then price premiums, stewardship payment and similar incentives are likely to serve as better incentives. To assess possible incentives that might motivate other farmers to adopt more environmentally sensitive management, case study farmers were asked what these incentives might be, and who should provide them.

The EMP farmers raised a wider range of potential incentives for others (22, with 13 issues exclusive to this group) than the EMS (12, with 3 exclusive issues), but only three areas (tax rebates/relief, rate relief, and ease of licensing requirements or reduced fees) were suggested by more than 20% of either group (Figure 69). These were the same incentives

the farmers had described for themselves. Most other potential incentives for others were raised by only one or two farmers in either group.

As the EMS group had undertaken a defined process approach to the development of their farm management systems, perhaps their thinking on the potential range of possible incentives had been shaped in similar ways. The EMP group may have provided a wider range of potential incentives due to the fact that they had utilised a more diverse range of methods to develop their management changes, and so considered a wider range of possibilities.

Interestingly, only farmers in the EMP group suggested regulatory relief as an incentive to encourage other farmers to change, whereas only EMS farmers had nominated

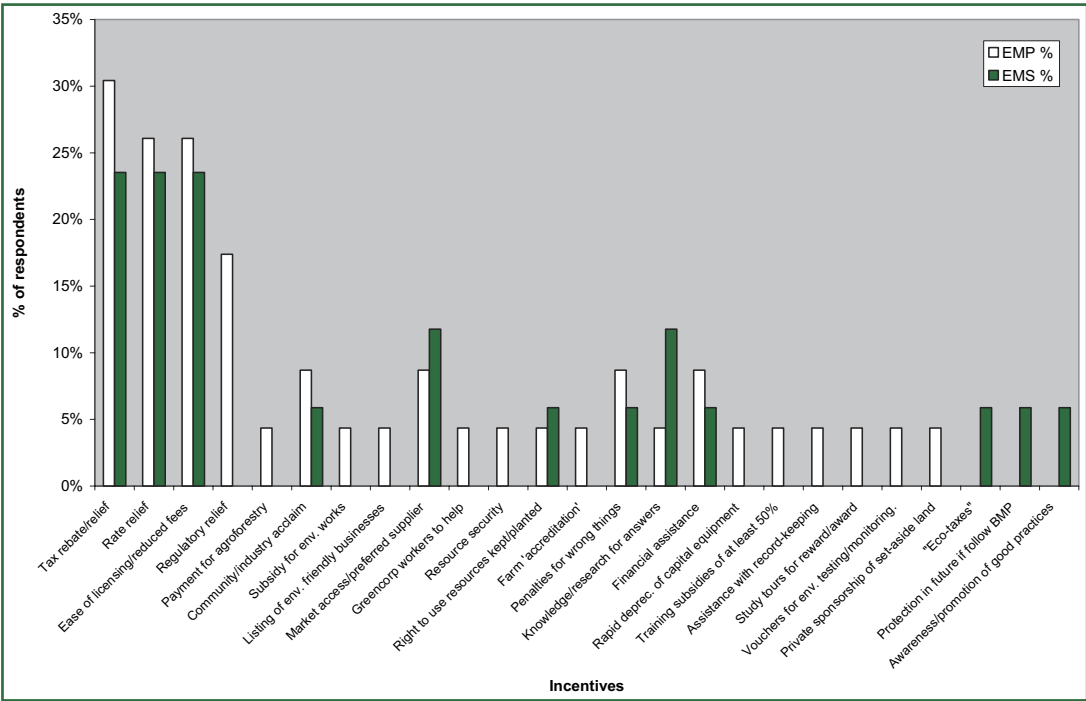


Figure 69 What incentives might encourage changes in others?

this as an incentive for themselves. This may have been due to the fact that the EMS group considered that they had now established regulatory compliance as a point of differentiation between themselves and other farmers, and so did not want to see this option as too readily available to others. It is also possible that the EMS group had originally focused more on regulatory compliance to begin with, and while they had looked for this sort of reinforcement for themselves, they did not consider it important for others.

Binning and Young (1999) proposed the use of rate relief as a mechanism to encourage conservation of native vegetation by individuals, and the results of the current study suggest that this incentive may be useful to achieve wider environmental management aims as well. Twenty-two other areas of potential incentives were identified, with six common to the two groups. However, as Binning and Young (1999) pointed out, other policy support would also most likely be required to support such incentives. The results of this study support the assertion of Coglianese (2001) that, in terms of gaining licences, both cost reductions and provision of longer-term licences could be useful to encourage changed behaviour by individuals. Linking security of tenure or ‘right to farm’ with demonstrable environmental stewardship programs was discussed by several farmers, all of whom recognised that some form of documentation or ‘proof’ would be needed to secure such benefits. Several EMS farmers said that their EMS was one way they could prove they were doing what they said they were.

Who should provide incentives?

The ‘government’ was seen as the most likely/suitable provider of such incentives by around 70% of the EMP and 50% of the EMS farmers (Figure 70). State (suggested by 2 EMS farmers) and local governments (one EMP and two EMS farmers) had a

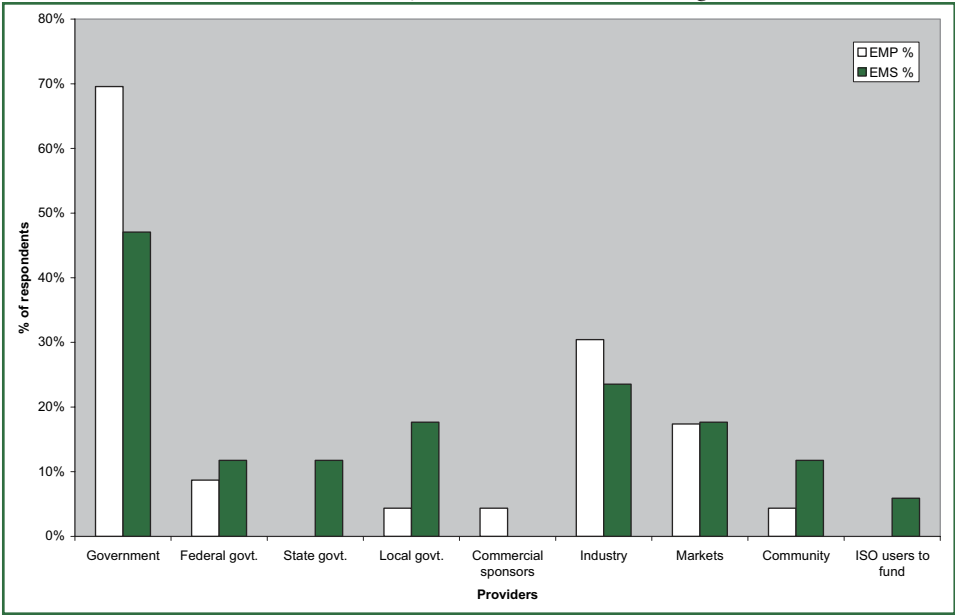


Figure 70 Who should provide incentives?

role here, with two farmers in each group specifying that such incentives should be provided by the federal level of government. As the most commonly suggested form of incentive was some sort of financial benefit, governments would be the most likely to have access to public funds to provide incentive payments, and thus it is not surprising that many farmers in both groups suggested that government should provide incentives. Governments are also the only group able to deliver regulatory relief.

Coglianesi (2001) suggested that public recognition, 'enforcement forbearance', and regulatory and permitting flexibility were government roles in encouraging EMS adoption. He discussed, in particular, the ease and low cost of providing public recognition by government – features that make these policy instruments attractive to governments – and pointed out that as involvement grows in such a recognition scheme, so the value of being involved drops. This sentiment was echoed by one of the EMS farmers, who stated that they did not want to encourage too many other farmers to adopt EMS, as they would then lose the 'edge' gained by using EMS to manage their own property.

A consideration when asking for government financial assistance is the need to validate claims for funding, and costs of administration of such programs. Some farmers in the study expressed the desire for guidance on how government funds were allocated at present. Several farmers in the EMS group stated that if farmers wish to receive public funds to support environmental works, then they need to open themselves to increased scrutiny of their performance. This was one reason at least two of the EMS farmers had undergone external auditing – they felt that this gave them more credibility than self-declaring outcomes of environmental performance. In addition, should there be a growing demand for such government assistance, government agencies are unlikely to be able to meet the demand except by using a 'fee for service' basis. Who would bear the administration costs of such a program? Governance requirements such as validation of claims, auditing, harmonisation of the validation/auditing and certification, and similar issues would need to be resolved – on a fee-for service basis, presumably. Finally, there is a need to define just who the 'user' is – the farmer who received some form of recognition (and therefore incentive) or the product end-user.

Both groups of farmers (30% EMP and 24% EMS) suggested that industry bodies could be providers of incentives. One EMS farmer further suggested that farm businesses who use and are certified against the ISO 14001 Standard should contribute to a fund to promote consumer awareness of the Standard and of sustainable farm management, as a way of encouraging consumers to preferentially purchase products from certified farms. Two EMS farmers and one EMP farmer suggested that the community might provide incentives to farmers.

It is interesting that less than 20% of farmers in either group suggested that markets might provide incentives, when almost half of both groups had stated that markets were a major driver for change in management behaviour. It is as though farmers recognised that they would have to change to meet markets, but did not expect any reward, such as premiums, for doing so.

3.19 The future

Farmers were asked how they saw their management evolving, and what environmental or management issues they might include in the future. They were asked to comment on the roles and leadership expected of their industry group and government/regulatory agencies in the area of environmental management. Finally, they were asked whether they thought consumers and/or supermarkets could influence farm management in the future, whether more accountability for farm management practices would be required in the future, and whether they thought their farm management systems would help them meet this accountability.

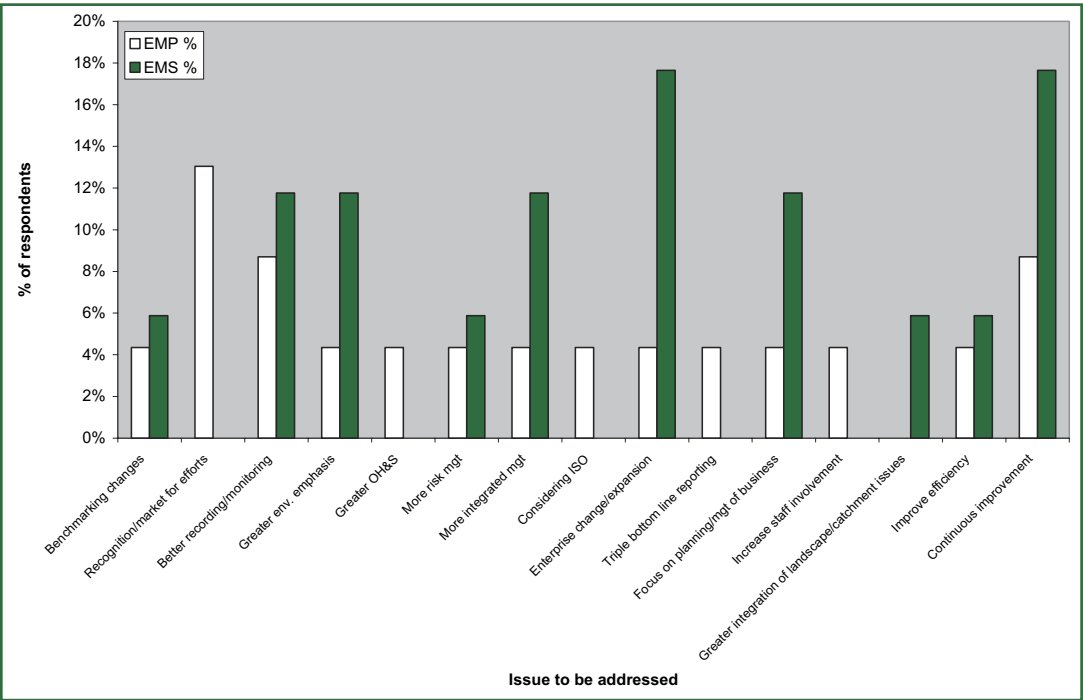


Figure 71 How will environmental management evolve on the farm in future?

Future management on-farm

For EMP farmers, the most frequently mentioned change to management (three farmers only) would be to gain some sort of recognition and/or marketing advantage (Figure 71). No EMS farmers nominated this category. Two EMP farmers said they would address better recording and/or monitoring

and two raised continuous improvement. Single farmers raised 11 other areas. Several of the categories raised by this group were to do with business management in areas already addressed by the EMS group (for example, recording/monitoring, risk management, and staff involvement).

For the EMS group, changing or expanding existing enterprises, and applying continuous improvement philosophy were the two most commonly mentioned future changes (three farmers only). Two farmers nominated integrated management, better recording/monitoring, increased environmental emphasis and more business /management focus. All other areas were only raised by individual EMS farmers. One farmer in the EMS group said he would build landscape and/or catchment management goals into his farm plans to a greater degree.

These results may reflect the initial motivations of the two groups of farmers, with the EMP group more strongly motivated to meet market pressures than the EMS group. However, due to the low numbers responding to this question, it is not possible to determine any trends between the two groups.

Environmental issues to be addressed in the future

In terms of the environmental issues to be addressed on their farms in the future, the EMS group mentioned a wider range (21, with 9 nominated by single farmers only) than the EMP group (16, with 11 nominated by single farmers only), despite the EMS group already covering on average a larger range of issues in their existing farm management (Figure 72).

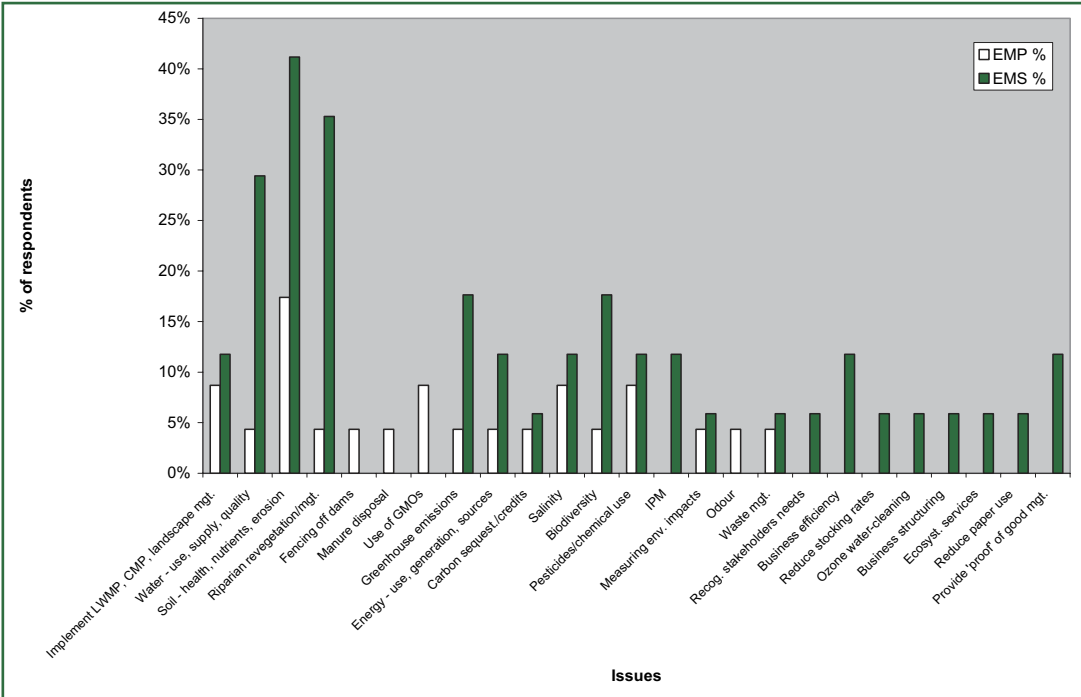


Figure 72 Issues to be addressed in future

For both groups, soil management (covering health, nutrients, and erosion control) was most frequently raised as a future issue (approximately 18% of EMP and 40% of EMS farmers). Land and water management plan implementation, use of GMOs, salinity and pesticide/chemical use were each raised by two EMP farmers and another 11 issues were raised by individual EMP farmers only.

Riparian zone revegetation and management (35%) and water management, encompassing use, supply and quality (29%) were the next two highest-rating issues for the EMS group. EMS farmers also more commonly raised issues in the ‘brown’ environmental arena – greenhouse gases and energy use. Business management issues (business efficiency and structuring, inclusion of stakeholder needs, and ‘proof’) were also raised by single farmers in this group.

The low number of respondents to this question again makes any conclusions tenuous but the EMS group did seem to have a greater focus on business management issues, as well as more farmers indicating they would deal with a wide range of environmental issues.

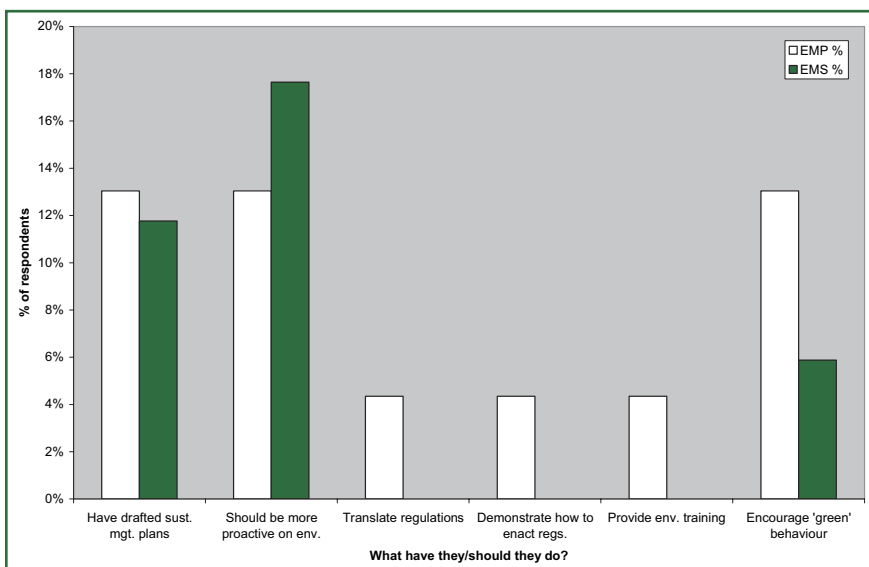


Figure 73 Role of industry groups in the future

and providing environmental training. Thus, the two groups were similar in their beliefs that industry should be more proactive in supporting and encouraging environmental management, with the EMP group providing at least three suggestions as to how this might be achieved.

When asked about specific tasks to be undertaken by industry in the future, the EMS

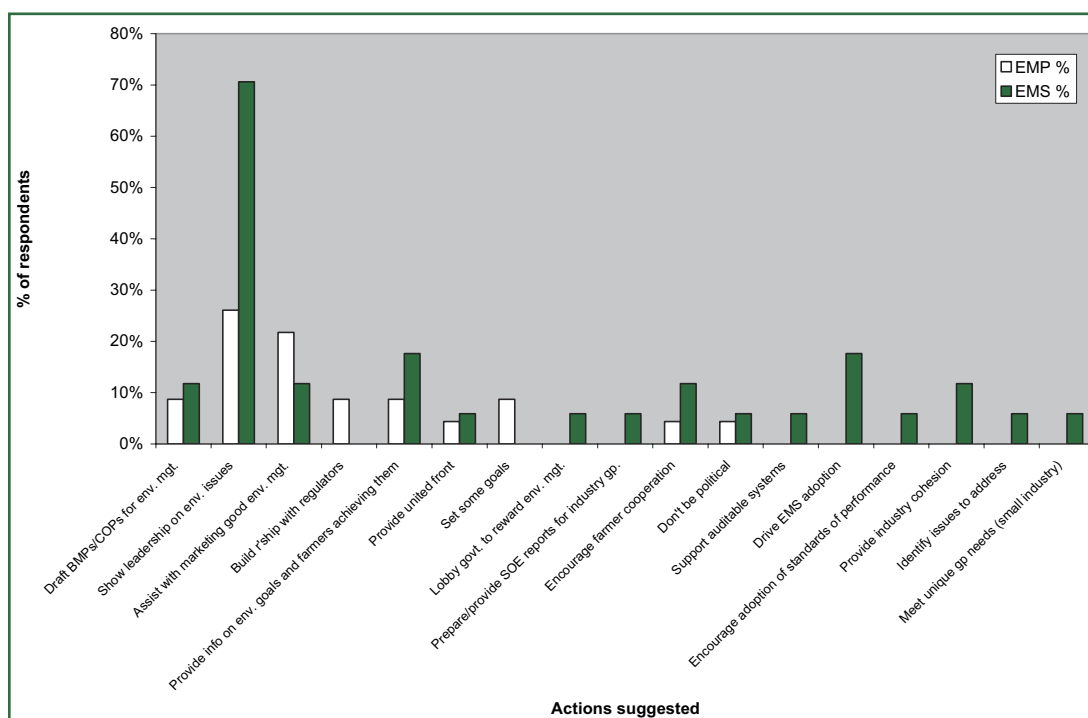


Figure 74 Specific tasks for industry in the future

Future roles of industry

Farmers were questioned about the role and expected leadership of industry groups in the future. Fewer than 15% of farmers in each group indicated that their industry sectors had already drafted sustainable management plans (Figure 73), with equal numbers stating that their industry sectors should be more proactive on environmental issues. Three EMP farmers and one EMS farmer stated that industry should do more to encourage 'green' behaviour. Single EMP farmers also suggested that industry had a future role in 'translating' regulations, demonstrating how these regulations could be enacted on-farm

group suggested a wider range of roles – 15, although eight were suggested by single farmers only (Figure 74). The EMP group suggested nine potential areas. Consistent with the desire expressed by both groups that industry should be more proactive in environmental areas, 25% of EMP and 71% of EMS farmers stated that they thought industry

should show leadership on environmental issues. Assistance with 'marketing' was more commonly raised by the EMP group (22%) than by the EMS group (12%), which may relate to the market pressures cited as initial motivations for change by the EMP farmers.

Coglianese (2001) suggested that industry groups form partnerships with governments to develop technical advice for industry members as a way to reduce the 'fear' factor of EMS. The use of templates was recommended, with governments contributing general information and support, and industry groups providing industry-specific information that allowed tailoring of environmental practices.

A few farmers in both groups suggested a range of industry-led activities that could assist in this area, such as development of best management practices, development of solutions to particular issues, and enhancing relationships with regulators. This is the approach that has been taken so far by NSW Agriculture in on-farm EMS support and, although progress is slow, results have been good. Such an approach saw the first and second grain farms in Australia (both featured in these case studies), and the second and third in the world, certified against ISO 14001 in 2001 (Carruthers and Tinning, unpublished). This work resulted in the development of an environmental self-assessment guide and a generic EMS example suitable for the grains industry (Tinning and Carruthers 2002 a, 2002b) which have been widely used in EMS development in Australian agriculture.

Provision of information and leadership were common themes that emerged from the EMS group, with several farmers also stating that industry needed to provide some sort of benchmark or standards of performance against which farmers' management could be measured. The use to which industry benchmarks can be put was discussed for the viticultural industries by Campbell-Clause (2001). Here a private consultancy firm worked with vineyard owners to capture information relevant to their own businesses in order to make more informed management decisions. Data regarding environmental outcomes arising from EMS implementation on-farm could be very useful in the development of such benchmarking information. However, the means to capture and make available this data are currently lacking.

Future roles of government

Government and regulatory agencies were also seen to be providers of environmental information in the future (Figure 75) but both groups primarily saw government agencies as a means to support or encourage farmers (26% of EMP and 29% of EMS farmers). Facilitation of change, education, extension specific to EMS, provision of free information, and research (focused on environmental management rather than production) were also roles suggested for government and regulatory bodies.

Mech (2002) suggested that provision of information on environmental performance outcomes, legal/regulatory issues and consumer information about EMS should be a government role provided for the public good. Metzenbaum (2001) also suggested

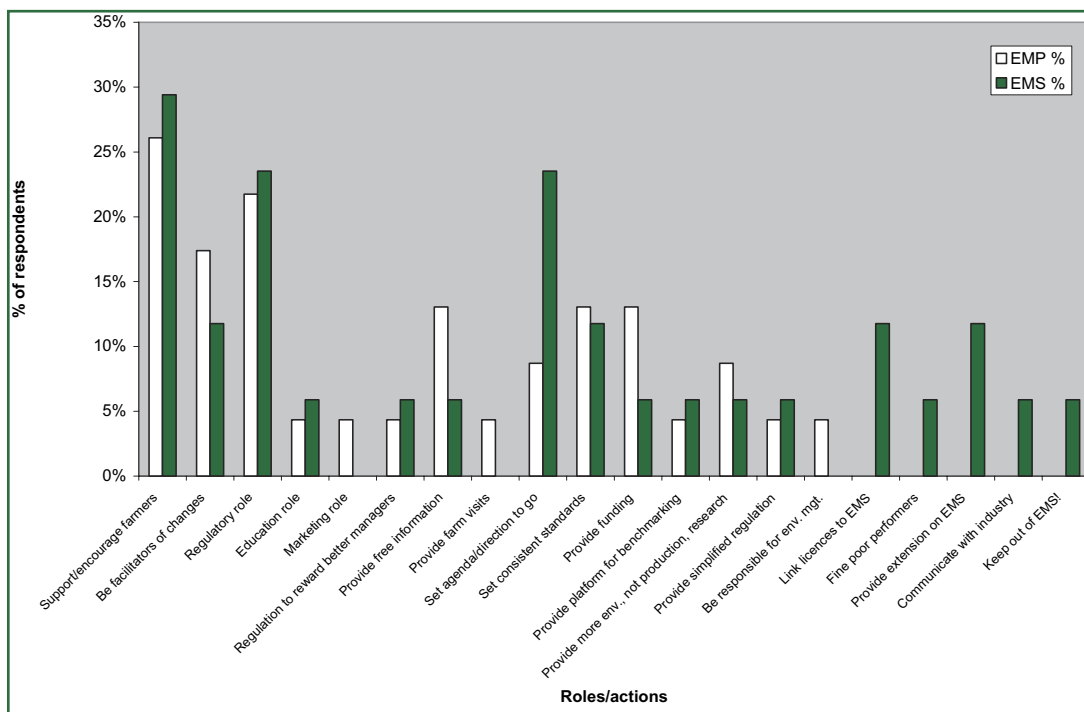


Figure 75 Future roles for government and regulators

that governments could either act as a convenor of information or 'stimulate information entrepreneurs through activities such as information standardisation'. Such information could feed into the national State of the Environment reporting structures that are already established in Australia. Andrews et al. (2001) reported

that small enterprises saw government agencies as important in providing assistance to businesses adopting and implementing EMS. This role became increasingly important if the business was not involved in international trade or part of a larger organisation. This assistance would be even more valuable to farming businesses, who are the least likely to have sufficient resources to develop such information on their own.

Over 20% in both the EMP and the EMS groups stated that governments should maintain their regulatory role. The EMS group also had a number of farmers suggesting that governments/regulatory agencies should tie licences to use of EMS and/or fine poor performers. Around 25% of the EMS group expressed the desire for government to either clearly state an environmental agenda, or to specify the direction environmental management should take on-farm. It may be that this group again felt that they had protected themselves against such punitive measures through their EMS, and thus believed that they would have no problem meeting such regulatory demands.

Similar numbers of farmers in both groups stated that governments should set consistent standards of management. Concerns were expressed during interviews about regulatory agencies changing their policies and recommendations or not providing clear enough information against which to make management choices. A commonly expressed statement was 'They won't tell us what they want, but they fine us if we get it wrong'. The apprehension created by uncertainty of specific performance requirements frequently had the effect that no action was taken to address certain issues, for fear that expenditure to address the particular issue might be wasted in the event that the solution 'wasn't quite right'. A related issue was the fear that, even if an action was

taken using the current best available practices, should future changes in thinking mean that the particular practice became outmoded, then somehow the farmer would be 'punished'. Addressing these concerns through clear and collaborative target-setting would have the effect of building cooperative responses to environmental issues.

Future consumer/market influences

Farmers were asked how consumers and/or supermarkets could influence farm management in the future. Around 30% of both groups thought the consumers would select 'clean, green' products in the future, which would influence farmer behaviour (Figure 76). Three of the EMP farmers and one EMS farmer thought that use of assured suppliers could also influence farmer behaviour in the future.

Perhaps reflecting the industry unfamiliarity with EMS, four EMS farmers but only one EMP farmer, stated that an awareness campaign was required to educate consumers about sustainable farm produce. Two farmers in each group stated that consumers would increasingly demand traceability and 'proof' of 'green' management. EMS farmers also suggested that branding was needed to distinguish products from farms with an EMS.

Government and industry both have a role in educating consumers about farm environmental management initiatives and EMS (Mech 2002). The use of branding, advertising, niche marketing and promotion of sustainable products were all raised by farmers in the current study as issues that could affect consumer preference. A few farmers in each group mentioned

price premiums as another positive influence. Two EMP farmers and one EMS farmer suggested that a 'sustainability' tax be levied on produce, with proceeds returned to farmers who could demonstrate environmental outcomes on-farm.

Areas of influence that were seen in a negative light were imposition of QA or EMS approaches and discounting of 'non-sustainable' produce, with one EMP farmer stating

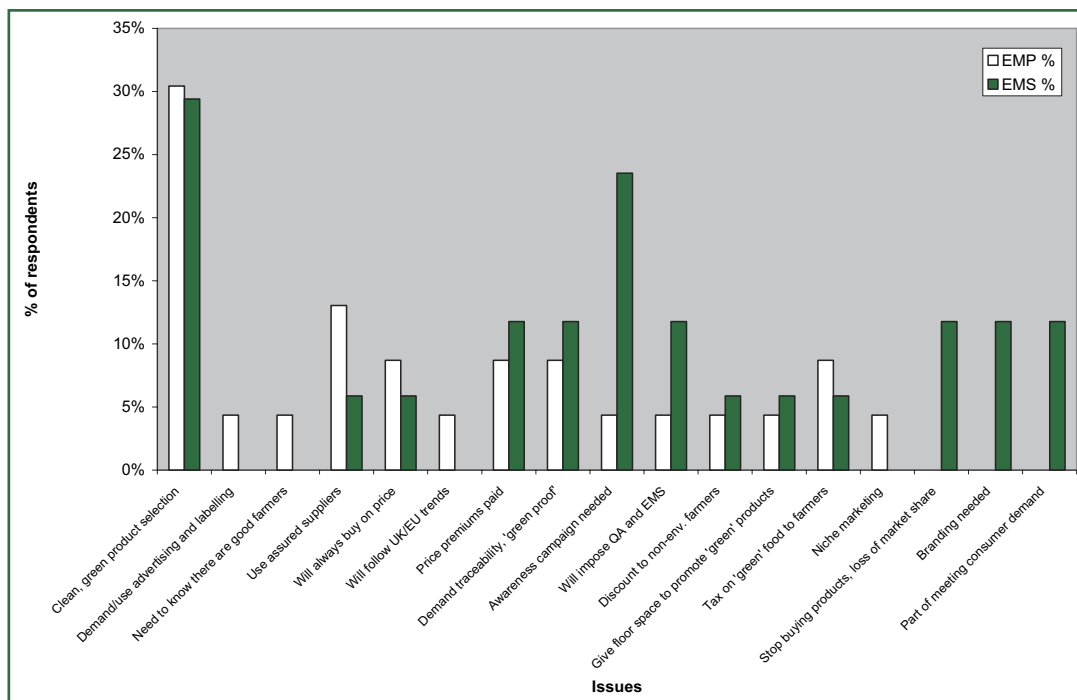


Figure 76 Consumer/Market influence in future

that he believed consumers would always make purchasing decisions based on price alone. Two of the EMS farmers thought it was possible that consumers could cause a loss of market share by refusing to buy unsustainable products. Most of the participants interviewed anticipated that consumer-buying patterns would drive farmers' behaviour more strongly in the future.

Future accountability

When asked if consumers and others would require farmers to be more accountable for farm management practices in the future, all farmers in the current study indicated that they believed requirements for accountability of this sort would increase. They also all felt that their existing farm management would help them meet the need for increased accountability. Moomaw (2001) reported that adoption by a Kenyan flower farm of a suite of environmental and social protection features allowed them to meet customers' demands from the Netherlands for both environmental and social outcomes. While Australian farmers may not currently experience a great level of such demand from Europe, it is likely that such pressures will grow.

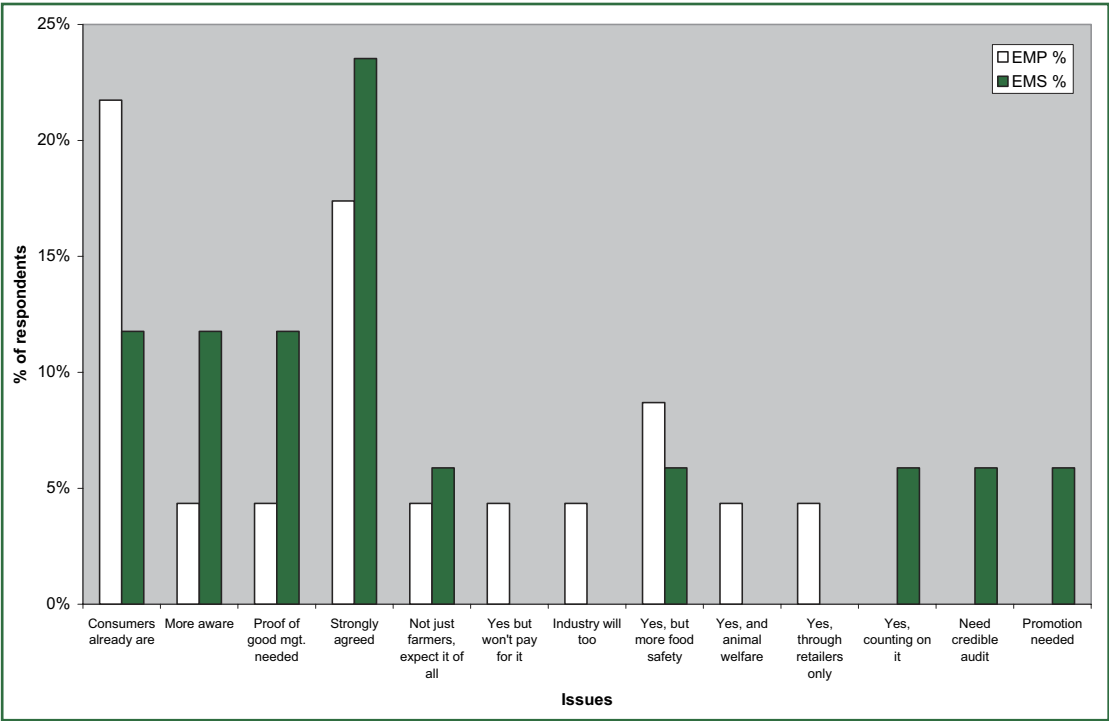


Figure 77 How will consumers require accountability?

Just under 25% of the EMP group and 12% of EMS group believed that consumers were already starting to require more accountability from farmers (Figure 77). Two EMS farmers and one EMP farmer felt that consumers were more aware and would demand some sort of ‘proof’ of behaviour. Two EMP farmers felt

that consumers would be more likely to demand accountability for food safety before environmental safety, but only one EMS farmer stated this. One EMS farmer stated that he was counting on this growing need for accountability and that this had been a driver for his addressing environmental issues in the first place. Promotion of environmental management was again raised by one EMS farmer as an issue here and the need for accountability in animal welfare was mentioned by one EMP farmer.

Figure 78 shows how participants thought their farm management approach would help meet the need for increasing accountability. Four farmers in each group (17% of EMP and 24% of EMS) strongly agreed that the changes they had already made on-farm would help them meet increased accountability needs.

Many felt that the records they were now keeping would be a way to have ‘proof’ of good management (35% of EMP and 29% of EMS farmers). They also raised the ‘proof’ issue in relation to use of systems (three EMS farmers, but only a single EMP farmer). Two EMP farmers mentioned that they would be able to use their QA records and audits to help them demonstrate accountability, with three of the EMS farmers citing their EMS audits as ‘proof’ of good environmental behaviour. Traceability was also mentioned by single farmers in both groups.

More EMS farmers (24%) than EMP farmers (9%) stated that they could demonstrate an environmental response on-farm, with two in each group stating that they could demonstrate progress toward addressing environmental issues identified. Other ways to meet requirements for accountability were raised by individual farmers in both groups. Offering protection to EMS users, should audits show environmental problems were occurring, could act as an incentive for EMS involvement as long as the farmers were able to demonstrate that they were addressing the issue. Coglianese (2001) recommended a similar response for industrial EMS application.

Thus, both groups recognised that the changes they had made on-farm would be useful in the future to assist them in demonstrating responsible farm management. For the EMS group, more so than the EMP group, the validation gained from external auditing and the matching of progress in environmental outcomes against identified risk and issues, provided further proof of their progress.

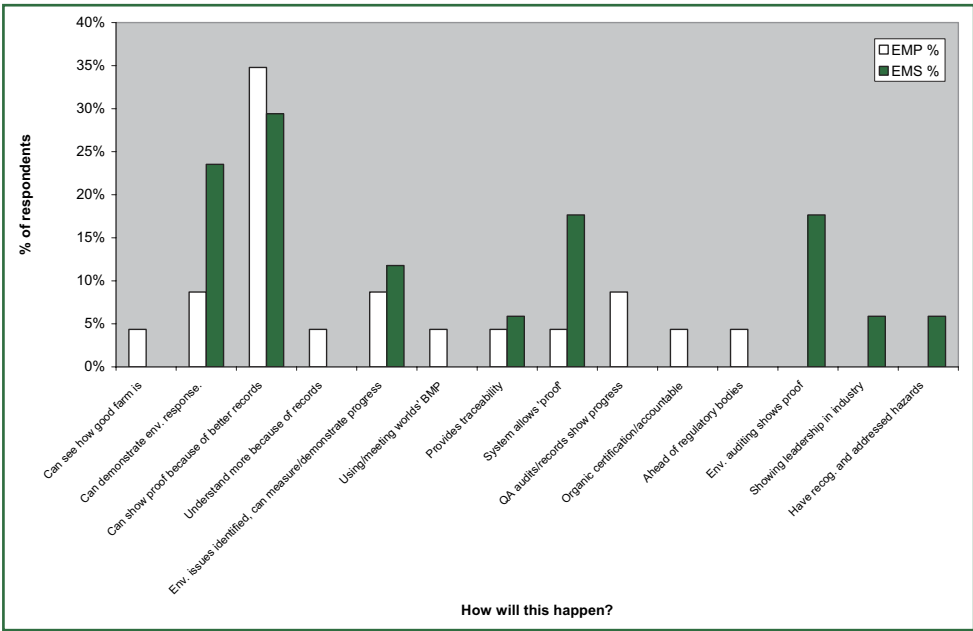


Figure 78 How will farm management approaches help meet the need for increased accountability?

3.20 Summary of differences found between groups

This report was based on information provided at a very early stage of EMS implementation on farms in Australia, and, indeed, the rest of the world. Similarly, relatively few farmers implementing an EMS were available for inclusion in the study, and many of those included in this study had immature systems and were yet to generate substantial data. Thus conclusions are tentative and may only be indicative of potential trends. However, in answer to the overarching question posed in this study ('Is there anything different about farmers who use an EMS?'), it did appear that there were some differences between farmers who did use an EMS – most notably in their business management approach and the outcomes achieved – and those who did not.

In many ways, the experiences detailed by the EMS group mirrored experiences recounted in other industry sectors, but differed in some important aspects, notably in drivers, issues addressed, sources of assistance and support, and cost.

Farmers interviewed were producing a range of environmental outcomes recognised by peers and agency staff. In general, the two groups were similar in terms of demographics, although more of the EMS group described their farms as corporate farms and typically reported having more overseas markets for farm produce. EMS farm staff were also more commonly reported to have tertiary training.

The EMS group conducted more risk assessments, were more focussed on a wider range of issues (including 'brown' environmental matters and business management) and they had a higher awareness of, and regard for, public pressure and compliance matters. As a group, they also rated issues more highly than the EMP group. To design their EMS, farmers had conducted in-depth analysis and identification of relevant environmental issues. Increased measurements and record-keeping also prompted more reflection about what they were doing – for both their business and the environment. Additionally, as many of the EMS group used consultants more and undertook more audits, it is likely that these factors were prompting them to cover more issues. This is particularly the case where consultants and auditors had come from a secondary industry background, leading to a greater focus on a range of 'brown' issues.

This study does not support the frequently made assertion that businesses implementing an EMS will not address biodiversity issues, as farmers with an EMS were more likely to report inclusion of biodiversity management in their overall farm management than were EMP farmers and, as a group, gave biodiversity issues a higher priority ranking. Farmer-Bowers (2000) examined the use of ISO 14001 as a means of protecting biodiversity of roadside reserves and claimed the common language of ISO 14001 enhanced development of objectives among diverse stakeholders who held uneven 'power' of the protection of biodiversity on these sites. He suggested that EMSs can play an important role in protecting biodiversity in these areas. The current study suggests a similarly important role for EMS for promoting on-farm biodiversity protection.

Both groups reported using a range of sources of information when planning and making changes to management on-farm. The EMS group was somewhat more likely to include regulatory agencies and local councils. This group was frequently unable to source information on, or assistance with, EMS and was somewhat less satisfied with information and support received from some sources than the EMP group. However, they were more satisfied with information received from regulatory agencies.

The EMS group was more likely to use environmentally related BMPs, COPs and similar. Therefore, use of EMS may enhance uptake of these support mechanisms, as it gives a framework in which to enact practices described and to assess the practicality and outcomes of such approaches.

Benefits of changes

A range of benefits was reported but both groups found it difficult to provide accurate figures for these benefits. In some cases, this was because the benefits were to do with personal attainment or confidence (and thus unable to be easily measured) but, in other instances, it was due to lack of accurate monitoring of such information. A similar number of benefits per farm was reported in both groups but the number of routinely used indicators per farm was higher amongst the EMS group. Regression analysis showed a significant relationship between the number of issues and indicators for both groups, but this was stronger in the EMS group. While a relationship was found between issues and benefits, again stronger in the EMS group, this was not statistically significant. No relationship was found between issues addressed and benefits reported for either group. A broad range of environmental, economic and social benefits was reported by both groups. Thus it appears that the EMS group was more closely linking the indicators used with the issues addressed, but benefits and issues were not as closely linked in reporting outcomes.

Market benefits for the adoption of environmentally friendly practices in general were not reported in terms of premiums, but some farmers in both groups stated they had retained or gained market access, and one EMS farmer reported gaining a price premium. The EMS farmers reported improved financial performance more commonly than the EMP group.

Business approach

EMS farmers tended to utilise a higher order of management approaches. These included use of risk assessment and management, greater review and reflection on progress, enhanced communication within and without the business, and greater emphasis on training and staff liaison. Whether this was due to following the EMS process initially, or because these farmers were more likely to use these sorts of tools anyway and were therefore predisposed to use EMS, is a future question. As the two groups were recognised as leaders in the areas of environmental management, it may be that the EMS group had already addressed many of the specific resource management areas described by the EMP group, and had moved onto more business or systems

related issues as areas of change. In addition, the risk-based approach used in EMS development and implementation appears to have allowed EMS farmers to tailor their management better to their individual operations, while also addressing the issues most pertinent to their own business.

Despite relatively high numbers in both groups indicating that they felt management should be integrated, the EMS group were more likely than the EMP group to be either already integrating, or considering integrating, management for all facets of business operations and were undertaking integrated auditing in several cases.

Increased knowledge

Farmers in both groups often reported an improvement in the knowledge of their business as a result of the changes they had made, but this was more pronounced amongst the EMS group. This is similar to the findings of Weeks (2003) and that reported by O'Sullivan (Gipps Beef Group MLA pilot, pers. comm. 2003) for farmers adopting EMS.

Both groups reported the value of record-keeping and improved monitoring that the changes to their management had brought about. While similar sorts of records were kept, the two groups had a different focus on the use of data generated, and the EMS group also kept a range of additional records in many cases (staff training and monitoring of the system). Greater attention to management practices provided a range of benefits to individuals in both groups and was supported through improved record-keeping and monitoring.

Cost of changes

While categories of expenditure were common between the two groups, in general the EMP group spent more on infrastructure and equipment and the EMS group reported spending more on consultants and auditing. This frequently arose due to the sourcing of information specifically on EMS from consultants and to undertaking more audits than the EMP group. The EMS farmers also reported that, in some cases, they had been able to combine quality and environmental systems audits, creating total auditing costs savings.

Anecdotal reports in Australia of costs for EMS implementation on farms seem inflated when compared with other industry sectors and may have resulted from inaccurate reporting of costs initially. Certainly, farmers in both groups of this study found it difficult to provide figures specific to adoption of environmental practices. In particular, environmental management costs were frequently not separated from those relating to production, and so were not easily defined.

Therefore, this study indicates that implementing an EMS may result in costs for gaining information and auditing specific to EMS, as a consequence of these services not being freely available from support agencies, unlike services relating to technical information on production or other issues. Conversely, the results also showed that the EMP farmers

were spending more on infrastructure and equipment – areas that the EMS farmers were often able to make savings in by rationalising equipment use and maintenance.

3.21 Barriers to EMS adoption – overcome, or not real in the first place?

Many of the barriers postulated to prevent farmers from implementing EMS (costs, time and increase in paperwork) did not, in reality, seem to feature amongst the EMS farmers interviewed. However, such barriers were raised by some in the EMP group. Increased paperwork, administration time, record-keeping and monitoring, were more often mentioned by the EMP group as a result of the changes they had made to on-farm practices (frequently to do with QA programs). While paperwork and documentation are key ‘fears’ expressed by those discussing or perhaps considering EMS use, the farmers in the EMS group of this study often did not seem to have found particular difficulty with these areas. In many cases, they actually found that their paperwork was rationalised to a degree. Thus, these barriers may be more in perceptions of those who as yet have little actual experience with EMS, than a reality.

During the interviews, farmers discussed barriers encountered when making changes—each had found their own way to overcome or, at least, ameliorate these. Florida and Davison (2001) found that larger firms were more likely to have greater staff resources to put towards EMS development and implementation, a major factor in the success of EMS adoption. However, for farm EMS implementation, many of the barriers present in corporate application (such as diffuse communication chain, convoluted chains of command and so on) are absent, and so EMS implementation may in fact be simplified. However, lack of time and resources remain as significant barriers for farmers.

Paperwork

Fear of increased paperwork is one of the chief barriers raised by farmers when initially contemplating EMS, and was one of the major drivers for the development by (the then) NSW Agriculture of a generic EMS manual for grain farms (Tinning and Carruthers 2002). This document was developed with grain growers to illustrate the possible formats for a farm EMS and to provide a starting ‘prompt’ for farmers, without mandating any particular way to address the elements of ISO 14001. Johansson (2002) suggested that provision of assistance with the documentation side of EMS could be valuable – a call echoed by some of the farmers in the current study. Riddiford (1999) reported that, by taking a collaborative approach to the development of EMSs specific for the Living Wine Group in New Zealand, development costs, resource sharing and group development of tools resulted. More importantly, fear of documentation was reduced, with peer support and friendly competition resulting between partners in the approach. Overcoming negative perceptions regarding EMS is another important area for consideration.

The fear of being ‘document controlled’ by an EMS rather than having document control in a management system did not seem to be validated by comments from

farmers, who in both groups found record-keeping to be useful, particularly in being able to provide 'proof' of stewardship. The EMS group, in fact, less commonly mentioned paperwork in responses to questions throughout the survey. Perhaps the focus on paperwork has arisen more from people who do not have practical 'hands-on' experience in EMS, but who rather comment from a theoretical (and perhaps ill-informed) background. Kirkland and Thompson (1999) also raised the problems associated with early EMS users not being familiar enough with on-ground implementation, but rather trying only to address the elements of the ISO 14001 Standard, rather than designing a workable system.

Perceptions

Knowles and Hill (2001) suggested that changing perceptions held by wineries about EMSs and ISO 14001 may be a more effective way to enable wineries to implement EMSs, rather than offering financial or technical assistance. Many of the farmers in this study had taken a 'can do' attitude to the changes they had made, and while the EMS group suggested that there had been reservations about EMS initially, they found that the actual experience had allayed many of these fears. A better understanding of the benefits that can accrue from improved resource management could be developed amongst farmers to break down perceived barriers. Overcoming these negative perceptions of EMS (amongst farmers and agency staff) is necessary, if enhanced adoption is to occur. A similar situation has applied when any new areas have been introduced in agriculture, the adoption of minimum tillage being only one example. As experience with the practices grows, and farmers become more comfortable, adoption slowly increases. EMS is likely to follow the same pattern, and thus expectations about adoption rates should be tempered according to the experience of adoption of any other new practice.

Audit costs and performance checks

Audit costs have been identified as a particular barrier. In some cases of EMS development in both Australia and New Zealand, EMS audit costs have been shared between groups of farmers (Riddiford 1999). Development costs for the systems have also been shared. If there are to be financial incentives provided for farmer involvement in enhanced environmental management, which may be demonstrated through the implementation of an EMS, then it is plausible to encourage farmers to work as groups and share audit costs. This occurs in Singapore where a scheme is in place to assist three to five SMEs in the same industry sector to save on EMS implementation and auditing costs (Tanner et al. 1997). Up to 70% of the environmental auditing and consulting service costs and 50% of the EMS certification costs can be provided under this scheme. The Minginew-Irwin group of farmers in Western Australia have developed EMS guidelines based on a combination of ISO 14001 and their existing QA programs, and are in the process of developing internal auditing procedures (Weeks 2003). Farmers within the group will provide auditing services to each other.

Some audit companies will do group audits, where a number of businesses within the cluster are audited and the costs are shared by the full group. Further surveillance

audits are conducted on a random basis. This approach has been utilised in Australian agriculture by a number of groups – initially in the grains industry by Carruthers and Tinning (unpublished 2001 – 2002), and more recently, by the Gipps Beef group in Victoria and the Traprock Wool Association in Queensland. This approach was also utilised by the NOSLaM group in New Zealand, by the Norfolk Fruit Growers' Association in Canada (Johansson 2002) and the Living Wine group in New Zealand (Riddiford 1999). Ammenberg et al. (2000), Johansson (2002) and Mech (2002) also raised the group approach to auditing as a way to overcome cost barriers to EMS implementation. Importantly, by participating in a group approach to auditing, peer support and discussion can also be generated.

An important consideration when seeking solutions to barriers to EMS implementation is whether the cost of certification need be borne at all. To answer this question, analysis of the reasons for implementation of the EMS needs to be considered. External pressure (be that from customers, community, clients or regulators) may mean that self-declaration of the use of an EMS process is not enough – 'proof' through external auditing might be needed. Knowles and Hill (2001, citing Barber 1998 and Hanks 1998) highlighted the need for 'industry-specific voluntary initiatives to "have a well-defined procedure for monitoring and evaluating performance and, for the sake of credibility, such systems should be independently monitored and verified"'. The best level of verification is the level that is appropriate to the individual users' needs (to paraphrase Johansson 2002). Farmers need to establish the best level for themselves, not have verification imposed. Several of the EMS farmers reported that they were using various 'care' QA programs to meet customer requirements, and got little value from them otherwise. They were often frustrated by the lack of harmonisation and co-recognition between programs.

Johansson (2002) highlighted an often-overlooked benefit of certification –that of the publicity provided by the certification or registration body, who promote their clients' achievements. Both EMS and EMP farmers raised their desire for recognition of the environmental work they were doing: to gain this recognition, some form of scrutiny may be needed but this scrutiny may be limited to the environmental outcomes their management produces. Therefore, the 'certification cost' barrier may eventually turn out to be a barrier artificially elevated in importance due to unfamiliarity with the EMS process and to misconceptions about EMS operations in general.

4. Future Needs and Recommendations

Familiarity

This study showed that there is a need for increased understanding and familiarity with the concept of environmental management systems in agriculture. Key needs identified were information (to flow in more than one direction), knowledge of motivations and helping farmers to discover and realise these, tools, and mechanisms by which farmers can be recognised.

Cary et al. (2002) suggested that, for farmers, it is particularly important to gain experience and familiarity with new practices at low/no risk to themselves, if they are to begin implementing these changes themselves. The use of demonstration farms, as employed by the Linking Environment and Farming (LEAF) program or by state/federal governments in several countries, would seem to be one way of providing this experience. Therefore, it would be prudent if, in Australia, state government research farms begin to implement EMSs on their own sites. NSW DPI has commenced this process at all of its research stations (although not all properties are expected to be subject to external auditing and certification). However, Friedman and Miles (2001) cautioned that, while 'showcasing' examples of EMS implementation is important, it may be difficult to generate such examples at a sufficient depth to be useful. It may be more effective to use a range of demonstration farms than trying to highlight all permutations in one enterprise.

The use of pilot programs can provide a stimulus to become involved in an EMS. However, Andrews et al. (2001) found that EMS developed as a result of pilot program involvement often had rather short-term objectives that focused more on compliance and pollution prevention than EMSs developed as a result of individual thought and effort. In the latter case, there was more variation and a longer-term focus in the objectives. In part, this may be due to the preferences and thought patterns of the person promoting and/or delivering the pilot program. Carruthers and Tinning (2003) noted that various monitoring and indicators developed to evaluate environmental impacts often relate more to the particular researchers' theoretical knowledge and background than the needs of the resource manager charged with addressing the issue. Care is needed, therefore, when undertaking pilot EMS programs to ensure that any EMSs developed are designed to meet the needs of the farm managers, not those of the researchers, consultants or auditors who may be involved.

Similarly, there is a need for awareness of EMS more generally amongst those who might provide support for farmers. Agricultural departments, industry groups, regulatory bodies and private farm consultants could all provide assistance to farmers – either in regard to specific technical solutions to environmental issues, or to EMS more generally. Farmers in the study who were seeking solutions to technical matters

were usually able to source free information on such issues. EMS farmers, on the other hand, were frequently forced to pay for information on EMS development, adding to their overall costs. The EMS farmers included in this study were the very early adopters – most had little, if any, external support from industry or agency staff. There were few resources they could draw upon, which added to the expense and time in developing EMS. Recent work in Australia to develop a range of tools and support materials for farmers implementing an EMS should be expanded and enhanced.

Support

The study has highlighted a number of areas of potential support required by farmers wanting to adopt more formal approaches to environmental management. The farmers themselves have suggested potential roles for stakeholders. Pretty (1995) outlined 12 policy areas that would support the widespread adoption of sustainable agricultural practices, many of which are equally pertinent to adoption of EMSs. These recommendations include:

- establishing a national {sustainable agriculture and integrated pest management} strategy
- giving priority to research into sustainable agriculture
- granting farmers appropriate property rights
- promoting farmer-to-farmer exchanges
- offering direct transitional support to farmers
- directing subsidies and grants towards sustainable technologies
- linking support payments to resource-conserving practices
- setting appropriate prices (penalise polluters) with taxes and levies
- providing better information for consumers and the public
- encouraging the adoption of natural resource accounting.

Statements by case study participants during interviews supported many of these recommendations. In terms of developing an overarching national approach in Australia, the National EMS Framework (Standing Committee to the NRM Ministerial Council 2002) provides an important initial step in developing strategic direction upon which to base EMS development.

Pretty (1995) went on to outline a range of further measures that could be implemented at the community level to support on-going change in agricultural practices by the wider community. These include the formation of local groups to foster better linkages between farmers, fostering rural partnerships, supporting on-farm training, and allocating local responsibility for landscape conservation. Amongst professional institutions, suggested mechanisms included encouraging participatory methods and processes; supporting information systems to link research extension and farmers; and developing a capacity in planning for conflict resolution and mediation. The use of EMS will fit into all of the categories suggested by Pretty and, in many ways, the standardised processes could enhance uptake of these mechanisms.

Utilising a peer support and education network such as that used in the LEAF program in the UK may be a useful model for EMS development in Australia. Peer hostility to EMS adoption also needs to be addressed.

Group support before auditing is important to assist in confidence and EMS development (J. O'Sullivan Gipps Beef. pers. comm. 2002). Mentoring programs have also been used within a supply chain context in the UK (Jones 2000) to encourage and support SMEs to adopt and implement EMS, and to provide relevant training, information sharing, enhanced monitoring and reporting between partners.

Group development of EMS also provide a mechanism where farmers can share costs and experiences in developing EMS, using small trials within the group to evaluate tools, technical solutions and similar approaches. Government resourcing could perhaps be provided in part for facilitators who could work across several groups, with funds also coming from within the group itself (similar to the approach taken in employing an agronomist or integrated pest management consultant that serves the needs of a particular group in one area). Using the services of someone who gains experience across a range of groups means that each individual group stands to gain from the experiences of a much wider range of parties.

Development of participatory and collaborative approaches, which combine research, trialling of new and innovative approaches and extension and/or training, in collaboration with industry and peer support and discussion, would seem to offer the most promising means to facilitate uptake of EMSs. The ability to network, discuss options, and gain experience from others undertaking similar changes has been found to be important to encourage SMEs to adopt EMSs in other industry sectors (Friedman and Miles 2001). Government support for such initiatives would be invaluable to the Australian farming community.

Information

The provision of easy-to-access, relevant and practical information on EMS and other forms on environmental management and expected outcomes is another area ripe for development. Farmers developing and implementing an EMS were frustrated generally by the lack of unbiased advice (that is, decoupled from consultancy services) and regarded highly the innovation of (the then) NSW Agriculture in providing a full-time officer to assist with EMS development. Since the study was undertaken, a range of EMS projects have begun across Australia but generally these are staffed by short-term appointed officers, who frequently have a specific enterprise focus to their work. Establishment of a national network of EMS facilitators (similar to the Landcare network) would be a great step forward.

Tools

Development of industry-specific guidance, examples and tools would be beneficial. However, farmers in this study did not want to see prescriptive performance outcomes being developed. Rather they favoured a flexible approach, allowing for innovation. Newbold et al. (1997) suggested that tools to minimise and control environmental impacts in agriculture are already used by many farmers, who may not recognise that they are using these tools. These authors grouped the tools thus; environmental

indicators, environmental impact assessment, agricultural codes of practice, life cycle assessment, environmental risk assessment, and the LEAF audit. Successful EMS development will depend upon ensuring that similar tools relevant in the Australian context are built in.

It may be that more EMS tools specific to agricultural enterprises should be developed. The Canadian Standards Association, for example, has drafted guidelines and requirements for EMS development for hog operations. These guidelines blend both ISO 14001 systems elements and specific environmental impact control into one document, and assist farmers in identifying and addressing environmental issues agreed upon as 'relevant' for their particular industry sector.

In addressing the difficulty of farmers' identifying aspects and impacts, it is worthwhile bearing in mind the assertion of Andrews et al. (2001) that use of generic checklists of aspects and impacts 'bypasses a critical thought process of identifying their own distinctive aspects and impacts'. In other words, in a desire to make things simple, there needs to be careful management to ensure that the individual manager is fully engaged and kept in full control of final outcomes. The system that is developed must meet the individual business needs. Tinsley (2002) also suggested that staff involvement in developing EMSs and various management strategies (in a group learning environment) are of more use to a business than solutions supplied by 'experts'. Industry groups could, and should, promote such group learning approaches in the agricultural context, with government agency staff able to provide assistance with group facilitation and extension.

Lewis and Tzilivakis (1998) described a computer-based environmental checklist auditing process that allows farmers to develop eco-rating for specific practices and evaluate these against perceived site-specific best practice. These ratings can then build into a targeted EMS program for each farm. Johansson (2002) described a number of tools available through the ISO 14000 Registry specific for micro-enterprises to use when developing EMSs. However, in order to tailor EMS as a tool for small businesses, simplicity, cost, maintenance, paperwork and time are all factors for consideration (Williams et al. 2000).

Newbold et al. (1997) developed a computerised EMS for agriculture that integrated quantitative self-assessment procedures with linked eco-ratings (which reflect environmental performance in fertiliser, pesticide, energy, water use, and conservation), information on legislation, formal EMS information, auditing, technical data, COPs, a glossary of terms and a contact database. This package encourages record-keeping and data collection, and provides 'what-if' scenarios for use by consultants and agricultural colleges. While the package is aimed at service providers rather than farmers, it is conceivable that a similar farmer-focused package could be developed in Australia. Provision of specific data linked to enterprise and location would be a useful addition. Such an innovation could be most usefully entered through the self-assessment process, where options given would link to both enterprise and location. In this way, a farmer

could complete a self-assessment which begins on a range of broad questions, with subsequent questions being streamlined according to earlier responses.

Delineation of expected outcomes

There is also a need to determine what outcomes are expected of EMS, both by individual users and society at large. As stated by Mech (2002), an EMS is not a panacea for all environmental issues. Speir (2001) raises some of the shortcomings associated with ISO 14001 when using it as a public policy instrument. If improved environmental management on-farm is desired only as an instrument to deliver public good, then supplementary public reporting of progress against prescribed performance measures may need to be included into the typical EMS cycle described by ISO 14001. However, if government wishes to take a hands-off approach, and yet be assured that a particular approach to addressing environmental management is being applied, ISO 14001 can provide this mechanism. The major point of distinction would appear to be whether outside assistance (i.e. money) is required to conduct environmental works—if so, then there should rightly be some form of performance evaluation and key performance indicators developed against which progress can be monitored and the ‘right’ to assistance be assessed. If, however, individuals wish to apply a systematic approach that has been shown to yield significant business benefits for their own purposes, with no or little outside assistance, then ISO 14001 would seem to be a useful process to apply (see also Corbett and Russo 2001).

Training for farmers, support agencies and auditors

Farmers who had adopted EMS had found sourcing support and information difficult, adding to the expense of developing their own EMSs. At the time the study was conducted, there were virtually no EMS facilitators available, and Landcare officers and other community groups were unable to assist. The development of a national training course specific to agriculture on EMS (Carruthers 2003a) has been an important development, but there is a need for a national network of skilled trainers and facilitators to assist farmers develop and implement EMSs.

The inexperience of many auditors with agricultural enterprises also needs to be addressed, as it can be a factor when these auditors estimate the time that an audit will take. Amongst the EMS farmers who had undertaken external auditing, there was a general feeling that few EMS auditors had a thorough understanding of the agricultural sector. Further training and awareness of agriculture-specific issues for auditors would seem warranted. There is a small, albeit slowly growing, number of EMS auditors in Australia who do have agricultural backgrounds available to work with farmers. Following the 1999 EMS workshop, several auditing companies reported that they were starting to recruit auditors with an agricultural background. EMS consultants are also developing more specific agricultural expertise.

Consistency between auditors should also be encouraged. While no Australian studies (to the knowledge of the author) have been undertaken on harmonisation of EMS

auditing procedures in Australia, Ammenberg et al. (2001) examined the interpretation of the ISO 14001 clauses by auditors, and found considerable variation both in processes and the interpretation of the Standard. Again, training of agricultural specific EMS auditors would appear to be prudent here to avoid such problems.

Further, a study of the auditors currently providing EMS auditing services to Australian farmers is recommended. Areas of consideration could include acceptable standards for identification of aspects and impacts, demonstration of required procedures and outcomes, and monitoring procedures.

Understanding of motivations and drivers

It will be important to more fully understand the initial motivations for EMS adoption, and their relationship to the issues addressed and the eventual outcomes achieved. We need to question whether EMS adoption creates improved environmental performance, or whether the commitment to improve performance is expressed through the mechanism of an EMS vehicle. At present, in the case of Australian farmers, we cannot answer this question. Coglianese (2001) asked a similar question regarding the industrial application of EMS, and was unable to provide an answer. In addition, not only the environmental outcomes, but also the social and financial benefits, require further scrutiny.

Incentives

Regulation and the fear of being fined did not appear to be major drivers for either group, and thus regulatory-based incentives are unlikely to be significant factors prompting the implementation of an EMS (although there appeared to be some scope for use in licensing arrangements, in certain industry sectors). The EMS group, however, did suggest that regulatory relief may provide an incentive to develop enhanced management practices. Coupled with this, and the expressed need for government support and assistance, it would appear that there is an opportunity for regulatory agencies to provide support through partnership programs for farmers to develop and implement EMSs. Recognition of the use of EMS may provide one mechanism for regulatory relief and/or self-regulation potential for agricultural industries, an approach now being used for agriculture in Wisconsin under the “Green Tier” program (J Shenot pers. comm. 2003).

Panayotou (2001), citing a 1995 survey of chief executive officers of 11 US corporations, claimed that the most effective way to improve acceptance of ISO 14001 EMSs would be to provide stronger regulatory incentives, strengthen trade benefits and increase public awareness. The latter two options would seem to be the most likely to succeed within the agricultural context in Australia, as regulatory drivers do not appear to be creating significant impacts on farmer thinking and decision-making at present. However, Knowles and Hill (2001) also reported that small wineries in South Africa stated that they would wait to be ‘forced’ into using EMS by their markets, lending support Panayotou’s second suggested mechanism.

In Australia, assistance with making the initial changes to management (the adjustment or transitional costs) would go a long way to providing farmers with the confidence to commence change towards EMS, as such assistance reduces the initial risk. However, developing overly stringent requirements for allocation of funding, without linking requirements to a risk-assessment based analysis of individuals needs for financial support, may limit the uptake of such assistance. Provision of financial support should also be linked with monitoring programs to demonstrate outcomes arising from such expenditure.

Corbett and Russo (2001) also sounded a note of caution regarding incentive programs to encourage EMS implementation as a means to achieve community good and common environmental outcomes. They advised that careful consideration be given to incentive programs, to avoid 'rewarding failure' by providing incentives to the worst environmental offenders.

Metrics

Ways to measure the success of an EMS within the agricultural context are needed. Davis (2000) recommended that in the early stages of EMS implementation, the means of defining success and developing metrics are two of the most important issues to be controlled. Any national program to encourage the adoption of EMS amongst farmers should also consider these factors. In the case of agriculture, it is imperative that measures of success are also agreed with external stakeholders, in order to reduce the potential for urban/rural conflict.

At present, one of the few ways to determine if an EMS is 'successful' is by whether the system meets the requirements of external certification. Often, however, such certification is neither needed nor wanted by the business manager. Instead, meeting a range of environmental outcomes (as developed by community groups, industry groups or agencies) may be desired. An agreed range of metrics and indicators which meet the needs of diverse audiences could potentially be developed. An emerging area for consideration is how well an EMS (or any other management approach) might enable managers to meet catchment targets. Little has been done in this area, but common processes according to EMS principles of defining issues, determining outcomes and adjusting management accordingly between farmers and catchment management authorities should enhance progress.

If EMS adoption is driven by the desire for public acclaim and approval, there need to be easy ways to measure and communicate the outcomes achieved, combined with an awareness of what an EMS is and does. In addition, the methods used to achieve the desired outcomes may also need to be communicated and understood. This implies that there needs to be combined communication, monitoring and agreed measures and outcomes, developed in a collaborative way – a process most likely to be facilitated by governments. Tools and measures (metrics) to assist with the evaluation of benefits of EMS implementation, and indeed of other forms of enhanced environmental stewardship, are required.

Many of the farm and business management approaches described in this report had only been in place for a very short period, and so monitoring and data collection were frequently ‘immature’. At present, a detailed analysis of motivations, costs, and benefits is difficult. Andrews et al. (2001) found that not all facilities using an EMS reported direct economic benefits arising from EMS adoption; however, managers believed that using EMS had been a worthwhile process. Using the ISO 14031 process for environmental performance evaluation can also yield significant planning information on which to base enhanced environmental management (Løkkegaard 2000). While farmers in Australia (or elsewhere) have little experience with this approach, following the ISO 14031 processes can provide direction for management, operational, and environmental condition indicators that could be built into an EMS. Overall though, the sorts of data generated from an EMS will differ depending on the end-user – if the EMS is being developed to demonstrate a general approach of ‘good stewardship’ and specific environmental outcomes, then the indicators chosen will likely differ from those of a system set up specifically to provide information on the cost effectiveness and environmental outcomes of a regulated farm demonstrating legal compliance.

There is also much to be done in the field of assessing intangible benefits that can accrue from adoption of advanced management approaches. Steger (2000), Andrews et al. (2002) and others have all highlighted a range of intangible benefits that can arise from EMS use. Pretty (1995), Panayotou (2001) and Speir (2001) all highlighted the need to be able to accurately measure improvements made in environmental performance accruing from changed practices.

Developing mechanisms for recognition of stewardship

Many farmers are hoping for market benefits in the future and see their environmental performance as positioning them to take advantage of these benefits when they become available. Development of clearer market linkages would support the desire to generate market returns for improved environmental stewardship. Although use of a certified EMS does not allow the practitioner to sell products as ‘environmentally friendly’, an externally certified EMS provides credible demonstration of both commitment to environmental management and progress towards defined consumer-mandated or preferred outcomes. As one farmer in the study expressed it, “The EMS stays on-farm, it’s the benefits we get from the EMS that we promote off-farm in our marketing”.

At present, it appears that consumers still focus more on food safety and quality issues than environmental matters. Farmers in this study indicated that they felt that animal welfare would be an increasingly important factor in meeting market demands in the future. The development of a means to signal superior performance in these areas to consumers to facilitate preferential purchasing is another aspect of development required.

Johansson (2002) described a web-based registry that allows businesses with an EMS based on ISO 14001 to post a profile of their business and which also serves as an on-line support and learning mechanism. Businesses using this facility may either

self-declare against the ISO 14001 or they may be externally audited. The Registry also provides for EMS verification through the “EnviroReady Report”, administered by professional accountants. The business’ EMS is compared to the requirements of the ISO 14001 Standard, with documentation examined using procedures detailed in the ‘Generally Accepted Accounting Principles’ scheme. The Canadian Institute of Chartered Accountants participated in the development of this program (Johansson 2002), and it is plausible that a similar approach could be developed for agricultural enterprises specifically (involving perhaps the Australian Institute of Agricultural Science and Technology as the verifying body). The Joint Accreditation Scheme of Australia and New Zealand (JASANZ) and SAI Global already operate a database of organisations certified against Australian and international Standards, but at present there is no readily available listing of businesses that may be using an EMS and self-declaring, rather than certified.

Enhancement of information and communication flow

An area that has received little attention so far throughout the world is the use that can be made of data generated by farmers as they apply EMS. Streamlining of communication has been described as one of the major benefits of EMS use (Steger 2000). It is clear that greater adoption of formalised approaches to environmental management will lead to more information becoming available to determine the costs and benefits of developing, implementing and maintaining an EMS, or indeed any form of environmental management.

Streamlining the availability of environmental information was seen as desirable by farmers in this study. Uptake of best management practices and codes of practices could be facilitated by use of EMS, and data exchange enhanced considerably between farmers and agencies where partnerships approaches were adopted. Improved information regarding catchment targets and specific on-farm actions to allow the meeting of these targets was sought. Farmers could also provide data back to agencies to better inform future target setting.

Validation of catchment environmental targets is one area that could greatly benefit from an injection of current real-life data that would be generated. Mechanisms to capture and utilise such data need to be developed, while protecting the anonymity of the farmers generating such information, and processes to update and alter targets and targeted performance parameters should be agreed upon by stakeholders. A national database and case studies of outcomes of EMS adoption (such as that developed by Andrews et al. 2001) specifically relating to agricultural adoption, would go a long way to providing the sort of information that farmers requested during interviews in this study. Information on this database could be used to provide motivation for other farmers, encourage ‘co-opertition’ (cooperation and competition), and allow for benchmarking of both environmental and general business management approaches and outcomes. Metzenbaum (2001) suggested that the ability to benchmark is a very powerful tool to allow both comparison of performance and emulation of successful managers. Issues of confidentiality of data would need to be addressed in order to encourage participation in data-sharing programs.

It may be helpful for EMS to use the models provided by LEAF or the TOPCROP model in Australia, where farmers send information on production to a central point, where the data is collated and analysed for trends prior to its return in a summarised form. The Australian Landcare Management System (ALMS) program will attempt to provide this sort of data collection and assessment, with particular reference to both biodiversity and catchment management targets. The success of such endeavours remains to be tested.

Integrated management and auditing

Integration of management appears to be enhanced by the use of a systematic approach. Many of the EMP farmers were using management practices that would meet requirements for EMS development. A range of elements was common between quality and environmental programs, and EMS farmers had successfully merged these practices and management approaches into their overall management.

In addition, many of the management elements partially encapsulated within many BMPs, COPs and similar are common with the management systems elements of ISO 14001, and ISO 14001 is seen as a means to integrate management. Harrison (2002) pointed out that, at least in the USA, extension programs have already provided many of these tools, that many of the elements required to implement an EMS are available, and that integration under one management approach can improve both economy and performance of an agricultural business. The challenge is how to assist farmers to use these tools most efficiently.

Further development of integrated auditing processes was an area under consideration or actively undertaken by several of the EMS group. The EMS farmers made the point that quality and environmental audits could be combined, along with financial and OH and S audits, if a systems approach was taken. The process approach described in ISO 14001 and the ISO 9000 documents facilitated combined audits. However, integration worked less well between EMS and some of the more prescriptive quality assurance programs. Development of improved auditing processes and enhanced auditor training is needed to overcome this areas of inadequacy.

Industry leadership and support

Industry leadership on environmental management generally, and EMS in particular (amongst the EMS farmers), was also sought by farmers in this study. The development of a published 'environmental position statement' by the industry groups could provide a baseline for all farmers to use when developing enhanced environmental management. Amongst EMS farmers, such a statement would be incorporated directly into elements dealing with environmental policies, aspects and impacts, and possibly monitoring and evaluation.

Industry support, in promotion of farmers who had achieved superior environmental management, would also serve to encourage others. Sadly, many of the EMS farmers in this study had believed that their industry did not support them in their changes and,

in fact, some believed that their industry group was actively working against them. As the novelty of EMS wears off, this situation is likely to change. In the meantime, active development and promotion of EMS tools and industry support for EMS projects will assist greatly in EMS uptake.

Government leadership and support

Harrison (2002, citing Repetto 1995) suggested four major ways governments can assist with environmental management program adoption: allow flexibility in setting and meeting environmental goals; promote permits with entitlements for the use of resources, such as emission trading; reward proactive environmental management throughout the entire economy; and build into the price structure of markets the costs of environmental degradation and/or preservation.

Provision of standards as 'base-line' compliance areas, but not prescriptive targets, was seen as a major role of governments. Government support could be expressed in a variety of ways, but most commonly farmers in the study saw that linking benefits with incentives to adopt improved environmental management through positive, not negative measures, would be the most successful.

Suggested mechanisms for encouraging further uptake of environmental management included: meeting farmers' desire for recognition of environmental stewardship: supporting management choices with information: providing regulatory relief through security of tenure and access to resources: and including funding for on-ground works. The increasing trend to link financial assistance to property plans would indicate that a similar mechanism may be useful to support EMS implementation, with the added advantage that the monitoring component of the EMS should provide information regarding the success or otherwise of management to achieve desired outcomes.

5. Conclusions

Around the world farmers are increasingly moving towards EMS implementation (generally based on ISO 14001) to provide them with a management approach into which they incorporate other specific areas, such as BMPs, QA and OH & S. In part, this reflects a growing knowledge of the existence of ISO 14001, but also represents a desire to improve the way environmental impacts are managed and to substantiate claims of 'environmentally friendly' production systems. EMS, as a tool, fits well into these roles. Other farmers do not yet perceive a need to adopt the formalised approach of the ISO process and choose to meet their current management requirements through other processes. This is often achieved by relying on the informal management approaches already in place (Knowles and Hill 2001). The path chosen is a result of personal preference, the degree of 'proof' required for environmental stewardship, and personal style of management. For many industry sectors, EMS has been used for much longer, yet only now are the sorts of issues raised in this report being examined. Early consideration of such issues for the Australian agricultural sector is highly beneficial, as workable solutions can be found earlier, barriers overcome more quickly, and adoption of EMS facilitated.

The experiences of farmers detailed in the current study provide fertile ground on which to begin the development of EMS tools for Australian agriculture. Building on existing industry initiatives will both promote ownership and encourage involvement, particularly if use is made of 'industry champions' to promote the concept. However, there will also need to be substantial development of support and extension services (whether through governments or private providers) within Australia to provide farmers with the assistance they require when developing either EMSs or other forms of enhanced environmental management. At present, many state government departments have neither the staff nor the knowledge to successfully support farmers in EMS implementation.

Moomaw (2001) suggested moving from EMS to wider 'sustainability management systems', which would incorporate increased community and social aspects and reporting. For agriculture, this may currently seem to be too great a step, given that heavy industry, with a much longer association with management systems, has not yet moved in this direction. However, integration of OH & S and social aspects within EMSs was shown to be possible in this study, with many of the EMS farmers not only including these areas in routine management, but also using integrated auditing to show that they were doing so. Good EMS design allows for integration, with the call for sustainability management systems being met already in many of the EMSs used on Australian farms. The demands for food safety animal welfare, and environmental stewardship were believed by farmers in this study to be increasing, and farmers were relying on their improved record-keeping and management to help them meet these demands.

Coglianesi and Nash (2001) highlighted that while a number of benefits arise from EMS implementation, there are still a great many questions to be answered as to the use of EMS as a policy tool. These questions are also relevant to agricultural application of EMS, and consideration of the agricultural and industrial applications of EMS at the same time would seem sensible.

In particular, it will be important to follow up whether the use of an EMS does provide greater long-term environmental benefits than non-systematic approaches. If, as Corbett and Russo (2001) postulated, businesses with poorer environmental performance get the most out of EMS implementation, then it is possible that the benefits reported by farmers in this study may be minor compared with the outcomes achieved by farmers who do not have such a focus on environmental matters.

A follow-up study in five years' time would provide very interesting comparisons to the data contained within the current report. In addition, as the number of farms using EMSs grows, paired comparisons between farms with and without an EMS in specific industry sectors would also prove useful in determining differences in approach and outcomes.

6. Appendices

Appendix A: Environmental management systems Case study questionnaire (RIRDC Project DAN 187A)

Interview with the Owner/ Manager/ Environmental Officer/Director/Senior Manager (circle appropriate) of (Name of Business/Enterprise/Farm).

Date Conducted

1. Farm Location

- Property/Business Name:
- Nearest Town:
- State:
- Latitude/Longitude (if possible):
- Bioregion (Tropical, Mediterranean etc. if known):
- Height above sea level:

2. Property Description

Size of property: (note ha or acres):

Area used by the enterprises (also include how long each enterprise engaged in and whether these enterprises are growing – G; declining – D; varied in response to market/weather – V or static – S:

Cropping: (break up into different crops if needed)

Grazing Sheep: Cattle: Goats: Horses:

Pastures Other grazing?

Intensive agriculture areas (poultry sheds/feedlots/piggery sheds/greenhouses etc):

Native vegetation:

Agroforestry/Plantations:

Shelter belts/Corridors:

Roads/Dams:

House/Sheds:

Fallow areas:

Other:

Soil types present on farms – include parent material (map if possible):

Slope class(es):

Orientation of main farm areas:

Vegetation communities:

On-farm:

Surrounding farm:

Are there any drainage systems present (creeks, streams etc.)?

Are there any environmentally sensitive areas on the farm (eg. forests, wetlands, Aboriginal or other historical sites, remnant vegetation, significant threatened habitat, towns, villages)?

Are there any environmentally sensitive areas surrounding the farm (eg. national parks, state forests, wetlands, remnant vegetation, significant threatened habitat, towns, villages etc)?

Do you know of any endangered or threatened species either on the farm or around the farm?

How do you feel that your farm management affects the sub-catchment/ catchment?

How do you feel that the management of the sub-catchment/ catchment affects your farm?

3. Climate

Average maximum temps (include break-up into months if needed):

Average minimum temps (include break-up into months if needed):

Average rainfall (break into monthly if there are significant differences):

Period of maximum rainfall:

Average humidity:

Type of rainfall (even, storm, monsoonal etc):

Other features:

4. Farm History

Is the property a family farm?

If yes, when was it established and by whom?

If no, when was it purchased?

How has the condition of the farm changed since you took over?

How and why have those changes been made?

Enterprises:

Paddock boundaries/areas of usage alter:

Other changes?

Is it possible to get copies of some old farm maps/photographs etc. if they are available?

5. Farm Income

What is the proportion of income derived from the various enterprises?

Is there any off-farm income?

Has any of the environmental work on the farm been funded by outside sources?

Which enterprise (s) required the most amount of money/time spent on it to address environmental issues (regulatory, repair etc.)?

Has the amount of income generated from the particular enterprise(s) influenced management choices (i.e. – have you moved out of particular enterprises because of regulatory/licence costs, meeting required performance levels etc.)?

6. Prior Farm Management and/or Management Training

How long have you been farming?

If this is a career change, what did you do before?

Have you done any:

farm planning training? (If so, please list)

related management training? (list – eg. business planning, marketing, financial, computer etc.)

What level of education do you have (secondary/tertiary etc.)?

What level of training do other staff members involved in farm management have (if relevant)?

Are you or any family/staff members a member of (circle as appropriate and state who is a member of what):

Landcare?

Catchment management committee/board or group?

Industry group?

Market groups?

Focus groups?

Research group?

Other? (list)

7. Environmental Issues Covered in Farm Plan/EMS

What issues are being addressed in the EMS/farm plan? (list). For each one, assign a priority on a 1-low priority to 10 – critical priority.

Have any of these issues been addressed solely in response to regulatory pressure? If so, which?

How were these issues recognised (eg. observation/monitoring, communication with neighbours, EPA's, Dept. of Ag., researchers, industry groups, personal desire/preference etc.)?

Is there a written environmental policy? (If no formal policy, or not written, ask if the person can articulate it and record it here.)

8. Motivation for change

Was there any particular 'crisis' that stimulated change from previous/conventional management practices, or was the change a long time coming and a result of thought over time?

Were you pushed into making the changes by (circle, then expand on below)?

Resource conditions?

EPA or similar reg. agency?

Customer/buyer?

Other motivation/drivers?

When you started out, what were your overall management goals? Did they include a major focus on environmental issues?

Have those goals been achieved? If only partly, how well?

Have those goals now changed? If so, why and what are they now?

What were the drivers of change (eg, market, self-choice, regulatory agency)?
What are the markets for the products from the farm – domestic or international?
If international, what areas (Asia, Europe, USA, UK, other)?
Did any market pressures influence management changes?
Are you getting market signals with regard to environmental issues in farming? Are these clear or ambiguous?

9. Confidence

How confident do you feel that planning and management changes are assisting in your overall management now? (Rank from 1-not very to 10-extremely).

Why? ie. Has improved, longer-term planning helped increased certainty in decision-making?

How confident are you in the future of your farm? (Rank from 1-no confidence to 10-strong confidence.)

Why?

How confident are you in the future of your industry? (rank from 1-not very to 10-extremely.)

Why?

Has your confidence in the industry/your farm affected your investment in environmental management? How?

How confident are you that your investment/changes will assure your future farming in your current industry and /or at this site? ? (rank from 1-not very to 10-extremely).

10. Management Changes

What has changed in management? (circle, then expand on below)

- Soil management
- Water management
- Nutrient management
- Chemical application and storage
- Tillage practices
- Stocking rates/management
- Matching land use to land capability
- Recycling/alternative waste utilisation
- Efficiency of resource use
- Pollution prevention/control
- Mix/integration of enterprises
- Business approach (more planning, review etc)
- Vegetation management
- Biodiversity management
- More attention to planning (and longer-term planning)
- More attention to monitoring
- More attention to recording (goals, monitoring results, outcomes etc.)
- Increased communication with neighbours

- Increased communication with regulators
- Increased communication with customers
- Other

11. Methods of Changes

How did you make the changes to management? (Circle, then expand on below)

- Did it yourself
- Did training, then did it yourself
- Used a consultant
- Made changes based on personal observation
- Member of a group – changes as a result of group discussion/research (state which group and method of determining change)
- Adopted ISO 14001
- Adopted organic standards
- Adopted Holistic Resource Management principles
- Adopted other resource management principles/approaches
- Other

Were any Best Management Practice(s), Codes of Practice etc. used? (If so please list them below). Rank their usefulness from 1-not very to 10-extremely for each BMP/COP etc.

Did you previously have, or now have, any other management systems in place (such as QA programs, OH and S, HACCP, SQF 2000, own corporate systems)?

Do you think management systems such as QA, OH and S and environmental should be integrated? What do you see as the benefits and drawbacks of such an approach?

12. Sources of information

Where did you find information needed to make the changes?

How satisfied were you with information received from (1 – not to 10 – very)

Industry

Dept. of Ag, DPI etc.

EPA or Natural Resource Dept.

Other farmers

Greening Australia

Landcare

Industry group

Consultant

Neighbours

Researchers

Others?

Whom do you think should be providing the information required to make good sustainable choices?

How should the information be provided?

13. Indicators of change

What environmental indicators are monitored on the farm, how are these measured and how often are they monitored? Include such things as physical monitoring – soil/ water/leaf tissue testing as well as bird counts, vegetation condition assessments and management indicators such as financial reviews, communication with neighbours, EPA etc.

Issues	How measured	How often

How are the results of the monitoring incorporated into management decision-making? (eg. Is there an annual review, 6-monthly, weekly, pre-planting review etc?)

How are farm records (including management records, performance records etc) kept?

- Paper based/Farm diary
- Computer based (name program)
- Other

How well do you feel that your management changes have affected financial and environmental performance?

14. Communication with industry/other interested parties

Have outside parties (neighbours, regulatory agencies, other farmers, industry groups) been involved in planning changes? If so, why and how?

How are the changes to management and performance communicated to others (if at all)?

- Field days
- Articles
- Reports to industry/agency groups
- Conference papers
- Other

Which form of communication has worked the best?

If there has been community/neighbour and regulatory agency liaison, how effective has this been in resolving issues?

How do you keep up to date with any changes to legislation that pertain to the running of your farm (Include local to Commonwealth)?

15. Benefits of changed management

What have been the major benefits arising from the adoption of improved management?

- Better profits
- Better yields
- Lower risks/liabilities
- Easier to meet legislated requirements/licence requirements
- Reduced fines
- Reduced licence fees
- Ease of gaining licences

- Improved resource base (soil/water health)
- Improved stock/crop health
- Increased biodiversity/return of species
- Gaining approved supplier status
- Improved market access
- Publicity
- Tax/rate relief
- Better community relations/neighbour relations
- Improved industry image
- Greater peace of mind/time with family etc
- Greater confidence in management
- Less time needed to fix problems (environmental or business)
- Improved human health and safety
- Others (list)

Can you provide an estimate of what the financial benefits might have been (perceived or actual)?

What have the social benefits been (perceived or actual)?

What have the environmental benefits been (perceived or actual)?

Have there been any other benefits?

Of the benefits that have occurred, did you expect them all, or have some come as a surprise?

Have you sought, or received – (list as applicable)

- Certification (to what)? (if applicable)
- Market differentiation of products?
- Branding/eco-labelling of products?
- Assured supplier status?
- Community acclaim (eg. Land for Wildlife membership)?
- Industry acclaim or support?
- Awards?
- Other?

Has the change in management and/or associated keeping of records made it easier to assess the benefits (particularly the costs) associated with changed practices?

16. Costs of changes

What has been the cost of making changes to management? Some of these might be estimates and may be in terms of time taken to implement the changes.

Some of the costs might have been for

Training (self or staff).....	\$.....	time (days, wks, mths etc)
Employing a consultant.....	\$.....	time (days, wks, mths etc)
Infrastructure/capital equipment.....	\$	time (days, wks, mths etc)
Employing new staff.....	\$.....	time (days, wks, mths etc)
Monitoring costs.....	\$	time (days, wks, mths etc)
Administration costs and changes.....	\$	time (days, wks, mths etc)
Software.....	\$	time (days, wks, mths etc)
Audit costs (if applicable)	\$	time (days, wks, mths etc)

What has been the time taken to make the changes?

Have the changes in management made it easier to assess the costs associated with management?

What are some of the potential costs that would have occurred had the changes not been made? (If it is possible, estimate these – such as potential fines, time in dealing with EPA/neighbours/correcting problems etc.)

Have there been any disadvantages other than cost associated with changing your management to incorporate environmental goals? (List)

17. Marketing

Do you make use of improved environmental management in marketing? (If possible, obtain copies of any promotional material, or get photos of certificates held, labels, badging etc.)

Has this changed with time/management changes? (Describe)

18. Roles of government agencies, industry and individuals

How 1) supportive and 2) involved were the groups below to the changes you made?
(1 – not to 10 – very) Supportive Involved

Family members

Staff

Industry

Other farmers

Neighbours

Agricultural Dept.

EPA/sim

National parks/sim

State forests/sim

Land and Water Consv.

Natural Resource Dept.

Local Council staff

Landcare members

Resource management

agency staff

Researchers

Customers

Others (list)

Would you recommend that others do what you have done? What would you recommend that they do differently?

What support would you have liked to have received while you were making your management changes?

Do you believe that there should be some financial incentives available to people who can demonstrate that they are managing their farms in a responsible manner? What sort of incentives?

What other sorts of incentives could be made available that might encourage people to change (eg. tax rebates, rate relief, ease of gaining licences, relaxation of other regulations)?

Who should provide these (Govt., industry etc)?

19. Future of enterprise and agriculture

How do you see your management evolving in the future?

What environmental or management issues do you think you will address in the future?

What do you see as the role of your industry group(s) in the future – how much leadership do you expect them/want them to take in environmental issues?

What do you see as the role for Government/regulatory agencies in the future?

How do you think consumers/supermarkets could influence farmer management in the future? (Include in this the whole industry direction if applicable.)

Do you believe that in the future consumers and others will require that farmers be more accountable for their farm management practices?

Do you think your farm management systems will help you meet this need for accountability? Why or why not?

20. Other

Is there anything else you would like to tell me that you think might be of use in this study?

Appendix B: Directory of environmental management publications – procedures for development

Introduction

The directory of best environmental management publications provides an annotated list of publications that are readily accessible to Australian farmers to assist them to sustainably manage the agricultural resource base.

It is acknowledged that there is a considerable range of published material that focuses on improving productivity of agricultural enterprises. However, this Directory is solely concerned with Australian publications that focus on improved environmental management outcomes for agriculture.

It is envisaged that the Directory will be of value to farmers who wish to improve the environmental management practices for their current enterprises. The information would also aid the development and adoption of environment management systems for Australian agriculture.

The Study

A wide range of government agencies, non-government organisations, universities and research and development organisations from across Australia were contacted and asked to provide information about any publications they produced that had a major focus on improving environmental management of agricultural industries. Additional publications for potential inclusions were also identified through searches of the web sites and publication lists of targeted organisations, in particular the department of agriculture or equivalent in each state, CSIRO, and research and development organisations. Searches were also made of the catalogues of selected libraries including NSW Agriculture and University of Sydney.

A set of criteria was developed to determine the suitability of publications for inclusion in the Directory. The criteria used were:

- The publication contained comprehensive information on management practices that farmers can undertake that will lead to more sustainable use of the agricultural resource base.
- The publication was orientated towards Australian farmers.
- The publication was readily and publicly available (either 'in press' or available on the Internet). Material available only in libraries was not included, nor were journal articles.
- The publication was published in 1995 or after.

It was also determined that the Directory should include the following information about each publication:

- title
- date of publication
- author
- length of publication
- costs
- publisher
- where it can be purchased
- comment about the content of the publication.

Once completed, a draft of the directory was sent to each state department of agriculture. For publications relevant to their organisation, each state was asked to check the accuracy of information contained within the Directory and to provide any information that was missing. They were also given the opportunity to nominate additional publications for inclusion, or identify ones that should be removed.

Over 500 publications were evaluated for inclusion; of these approximately 100 have been included in the final Directory.

The Directory

While there is a wide range of publications available to Australian farmers, many of these are production focussed and provide little information on how farmers can change their management practices to result in more sustainable outcomes. The Directory concentrates on publications that have a major focus on helping Australian farmers improve the environment management outcomes for their properties.

Publications from New South Wales and the Australian Capital Territory

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Woodhead, A. Jenkins, A. Woods, M.	2000	<i>Acid sulfate soils: keys to success</i>	22 pp. colour photos, illustrations	\$10.00	ASSMAC and NSW Agriculture	NSW Agriculture	This book is designed to give landowners the ability to field test (soil and water tests) for ASS on their land. It also describes plant, soil and water indicators of the presence of ASS Increased knowledge and understanding of ASS will give land holders greater confidence about the land uses and practices that will help protect water quality.
NSW Agriculture	1997	<i>Best practice guidelines for growing vegetables</i>	34 pp. colour photos, illustrations		NSW Agriculture, Orange	NSW Agriculture	Best practice guidelines not only aim for a clean healthy crop, but are also a safe guard to stimulate and assist sustainable farming practices. K46 The guidelines cover planning farm layout as well as best outlining practice for soil management, irrigation, agricultural chemical spray use and crop fertilisation.
Brouwer, D. Bell, C. & Archer, C.	1998	<i>Bringing back the rainforest: the Tocal Experience</i>	Booklet, 34 pp	\$14.00	NSW Agriculture	NSW Agriculture	"Tocal" is a property managed by NSW Agriculture in the Hunter Valley of NSW. This book provides a unique look at the fate of a remnant rainforest and it's riparian zone. It shows the revegetation program and tells what works and what didn't. Many colour photos and species list.
Inter-Departmental committee on intensive animal industries		<i>Draft NSW Environmental guidelines for dairy effluent resource management</i>			NSW Agriculture	NSW Agriculture	Has been out public comments, these are currently being incorporated. Hopefully IDC will finalise it later this year ph Diane Ryan, EMail 4640 6378
Wilson, H. (ed)	1995	<i>Drip irrigation: a grape growers guide (2nd edition)</i>	72 pp. black and white photos illustrations	\$11.00	NSW Agriculture	NSW Agriculture	Aims to inform interested grape growers about drip irrigation, its requirements, advantages and disadvantages to help them decide whether it may be suitable system for them. Contains information on design principles, selection of equipment, management practices and economics of drip irrigation compared with other systems. Includes case studies of growers already using drip irrigation
NSW Agriculture, NSW Vocational Education & Training Accreditation Board	1999	<i>Farming for the future: property management planning workshop series</i>	course handbook & manual		NSW Agriculture, Orange	NSW Agriculture	
Watson, R. Freebairn, B. MC Donald, W.	2000	<i>Fertiliser: A key to profitable livestock production and sustainable pastures</i>	booklet, 28 pp. colour photos, illustrations		NSW Agriculture, Dubbo	NSW Agriculture	Provides information/guide on how to establish fertiliser program for pastures covers role of soil test, selecting paddocks for top dressing, timing and spreading of fertilisers and suggest fertilisers programs to suit selected nutrient deficiencies. Also outlines grazing management principles for good pasture management.
Brouwer, D. Bell, C. & Archer, C.	1998	<i>Fertilisers for your farm: their role in the environment</i>	booklet, 80 pp, illustrations	\$17.50	NSW Agriculture, Tocal	NSW Agriculture	This book aims to give landholders a basic knowledge of the principles of fertiliser use and to show how these principles can be used in growing crops and pastures. The book also examines the environmental effects of fertilisers and briefly introduces alternatives to traditional fertiliser strategies.
Kelly, P. Reeder, R.	2000	<i>Geared up: conservation farming equipment for central west New South Wales</i>	54 pp. colour photos illustrations	\$20.00	NSW Agriculture, Dubbo	NSW Agriculture	This book is about machinery for conservation farming and the principles behind many machinery issues. It is written for farmers as a guide to the 'hows' and 'whys' of conservation farming machinery rather than a 'recipe book'. It aims to provide enough information to put it all together in package that will work on a particular farm. The book covers tillage in conservation farming, stubble management, machinery components, seeders, modifying existing sowing machinery, fertiliser placement, controlled traffic farming and precision agriculture.
Brooke, G. McGarva, L.	1998	<i>Glove box guide to plants of the NSW rangelands</i>	156p. spiral bound, colour photos	\$11.00	NSW Agriculture	NSW Agriculture	This guide provides a quick reference to 127 of the more common and important species for pastoral management It has been developed to present the information most commonly requested by pastoralists about rangeland plants much of it derived from plants of NSW

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Campbell, T. Hacker, R.	2000	<i>Glove box guide to tactical management for the semi-arid woodlands</i>	68 pp spiral bound, colour photos illustrations	\$11.00	NSW Agriculture	NSW Agriculture	This book was prepared for graziers in the semi-arid woodlands who wish to practice tactical grazing management on their properties. It contains a number of simple field techniques which will assist managers to better assess their pastures and animals, and make grazing management decisions which are aimed at maintaining or improving the long-term productivity of their pastures. Companion guide to 'glove box guide to plants of NSW rangelands'
Betts, J.	1995	<i>Improved management of soils on north coast of NSW</i>			NSW Agriculture, Orange	NSW Agriculture	This guide outlines sustainable soil management guidelines for the central Lachlan catchment: The guide is comprised of 5 self-contained sections 1. The central Lachlan catchment: an overview 2. Managing soil structure 3. preventing and treating soil erosion 4. identifying and treating dry land salinity 5. identifying and measuring soil salinity
Butler, B. (compiler)	2000	<i>Lachlan soil management guide</i>	Book, 170 pp, colour photographs, illustrations	\$27.20	NSW Agriculture	NSW Agriculture	A book for farmers, students, environmentalists and anyone with an interest in Agriculture. Light soils represent a large area of NSW and are the most fragile in the state. Major chapters include: Pastures, Horticulture, Crops, Rotations, Managing acidic soils, Correcting soil acidity, Tourism, Long-term sustainability, Weed control, Managing livestock, Organic Farming, Preparing for drought, Pest control, managing soil fertility, Native plants and animals, Protecting water, silt, rivers, vegetation and animals.
Freebairn, B. Mullen, C. Madden, C. Carberry, P. Morrissey, P.	1997	<i>Light soils: managing them better</i>	Book, 165 pp photos (black and white), tables, illustrations	\$9.80	NSW Agriculture	NSW Agriculture	This publication presents information on water and fertiliser use efficiency in nurseries. These processes determine both the volume and quality of nursery waste water. Understanding them is the first step in developing effective strategies for minimising run-off. Recommendation for improving nutrient and water use are made
Cresswell, G. Hutt, D.	1996	<i>Managing nursery run-off – techniques to reduce nutrient leaching from pots</i>	40 pp, colour photos illustrations	\$21.75	NSW Agriculture	NSW Agriculture	A guide to irrigation, drainage and water recycling in containerised plant nurseries. It helps nursery operators use best irrigation management practices and meet nursery industry's national goals in: - efficient water use - increased re-use of waste water - effective management of sediment and litter - retention of nutrients - environmental responsible use of plant protection products
Rolfe, C. Yiasoumi, W. Keskula, E.	2000	<i>Managing water in plant nurseries – a guide to irrigation, drainage and water recycling in containerised plant nurseries (2nd edition)</i>	279 pp, colour photos, illustrations	\$66.00	NSW Agriculture	NSW Agriculture	A farm's creeks and streams are a vital resource for the farm manager and downstream users. This booklet outlines how to manage farm water ways to prevent erosion, reduce salinity and improve water quality. It includes case studies to show how to improve farm productivity by looking after farm waterways.
Brouwer, D.	1997	<i>Managing waterways on farms</i>	Booklet, 87pp, colour photos, illustrations	\$28 +	NSW Agriculture, Tocal	NSW Agriculture	While this booklet has been developed as part of NSW Agriculture's Home Study course Certificate in Landcare, it provides a useful reference for all those interested in improving management of farm waterways

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Brouwer, D.	1995	<i>Managing Wetlands on farms</i>	Booklet, 61 pp, black & white photos, illustrations	\$24 +	NSW Agriculture, Total	NSW Agriculture	Wetland areas benefit the whole farm. They can provide much needed biodiversity and protection for catchments. This unit shows how to combine management of wetlands with agricultural production. The book uses real case studies to describe management of natural and constructed wetlands. While this booklet has been developed as part of NSW Agriculture's Home Study course Certificate in Landcare, it provides a useful reference for all those interested in improving management of farm wetlands Nature conservation is about keeping or bringing back a wide range of plants, animals and other organisms on your farm that will contribute to its health, productivity and appeal. The aim of this book is to - raise your awareness of nature conservation on farms - consider how nature conservation can affect farm production - help you develop skills to tell if your farm is improving in biodiversity - give you some tools that allow you to develop nature conservation measures for your property
George, D. Brouwer, D	1996	<i>Nature conservation on farms</i>	Booklet, 118 pp, black & white photos, illustrations	\$33.00	NSW Agriculture	NSW Agriculture	
Akbar, S. Page 508 of 508	1999	<i>On-farm water storages: guidelines for siting, design, construction and management</i>	Booklet 28 pp,	NSW Agriculture,	NSW Agriculture	NSW Agriculture	This publication outlines each stage in developing a new on-farm water storage. Stages covered include evaluating alternative sites for the storages including investigating potential environmental impacts, and storage design construction, operation and ongoing monitoring. Technical appendices are included on locations for soil sampling, testing for suitable soils, aspects of storage design and compaction control.
		<i>Physical property planning</i>	Booklet, 148 pp, colour photos, illustrations				This book concentrates on the physical features of the farm plan. It is most applicable to dry land farming. The book reflects the planning process used in the Property Management Planning Workshop series. While concentrating on the physical components this book does not neglect the links between the personal, financial and physical but rather highlights these and encourages you to consider their importance. Shows in detail how to re-establish trees and shrubs on your farm. Includes how to plan a revegetation program and assess existing remnant vegetation. Covers natural regeneration, collecting native seed, weed control and protecting revegetated areas from livestock, insects and other threats.
Brouwer, D.	1998	<i>Plan for Trees; a guide to farm revegetation on the coast and tablelands</i>	Booklet, 67 pp, colour photos, illustrations	\$30.50	NSW Agriculture, Total	NSW Agriculture	Outlines principles designed to assist government and industry advisers in development of strategies for managing spray drift associated with the application of agricultural chemicals. To achieve its aim, factors are identified which can help minimise spray drift and reduce its economic, environmental and public health impact.
Farm Chemical Coordinating Committee	1998	<i>Principles of spray drift management</i>	18 pp	NSW Agriculture, Orange	NSW Agriculture	NSW Agriculture	This brochure aims to help North coast commercial vegetable growers maintain sustainable production by protecting their soil from the problems of erosion, compaction, acidity and nutrient decline
Eldridge, S.		<i>Soil management for commercial vegetables and small crops</i>		NSW Agriculture, Grafton	NSW Agriculture	NSW Agriculture	This guide is designed to help growers in orchards and vineyards with their soil management decisions. Both new and existing plantings are covered. The manual consists of 6 sections: citrus, grapevines, deciduous fruit trees, bananas, avocados, macadamias
McMullen, B.J.	1995	<i>Soil management for NSW orchards and vineyards</i>	2 ring folder – 6 sections, colour photos, illustrations		NSW Agriculture	NSW Agriculture	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Lines-Kelly, R. (ed)	2000	<i>Soil sense: soil management for NSW north coast farmers (2nd edition)</i>	224 pp, colour photos, illustrations		NSW Agriculture, Wollongbar	NSW Agriculture	This book is for farmers on NSW north coast. It helps you understand your soil so that you can manage it productively. It contains 3 main sections - an introduction to the landscapes, soils and agriculture of the coastal river catchments on the north coast - an outline of soil management techniques for the regions main farming systems - an alphabetical guide or glossary of soil science information relevant to farmers.
McKenzie, D. (ed)	1998	<i>SOILpak for cotton growers (3rd edition)</i>	4 ring folder – 6 sections, colour photos, illustrations	\$65.30	NSW Agriculture	NSW Agriculture	This provides a 'best practice' soil management manual for the Australian cotton industry. It focuses on irrigated cotton production, but contains a supplement for dry land growers. SOILpak concentrates on developing the skills needed to - assess the condition of the soil, with emphasis on soil structure - understanding management options for maintaining or improving soil condition.
Anderson, A. McKenzie, D. Friend, J. (ed)	1999	<i>SOILpak for dry land farmers on the central west of NSW</i>	4 ring folder – 6 sections, black and white photos, illustrations	\$27.20	NSW Agriculture	NSW Agriculture	The Red SOILpak is a guide to best practice management for farmers on the Central Western red soil country. This manual covers topics including: crusting, hardsetting, structural damage, low organic matter levels, sodicity, erosion (including loss of nutrients) and declining fertility
Phelan, J. (ed)	1999	<i>SOILpak for southern irrigators</i>	4 ring folder – 6 sections, colour photos, illustrations	\$65.30	NSW Agriculture	NSW Agriculture	Manual provides a guide to recognising soil groups, diagnosing soil problems. Best soil management practices for broad area irrigation farmers on the riverine plains in the Murray and Murrumbidgee valleys are described
McMullen, B.J.	2000	<i>SOILpak for vegetable growers</i>	4 ring folder – 6 sections, colour photos, illustrations	\$27.20	NSW Agriculture, Orange	NSW Agriculture	SOILpak targets the main soil groups used for vegetable growing and addresses the key soil management problems and strategies. Issues covered include managing soil structure, preventing and treating soil erosion and how best to apply fertiliser.
Anderson, A.N. McKenzie, D.C.	1998	<i>SOILpak pocket notes: a summary of "SOILpak for cotton growers, third edition" for use in the field</i>	33 pp, illustrations		NSW Agriculture, Orange	NSW Agriculture	Summarises information from the 'SOILpak for cotton growers' (third edition). Aims to provide field handy guide those who are familiar with the cotton SOILpak manual
NSW Agriculture		<i>Soils and their management</i>		\$88.00		NSW Agriculture	The second edition comes in a revised, sequential format and is presented in four parts. - Part I addresses the issues in starting a feedlot - Part II deals with feedlot operation and involves three new chapters addressing the use of both effluent and ,manure, plus requirements for environmental monitoring and reporting - Part III financial section - Part IV addresses specific management issues from breeding to health and use of growth promotants NB new version is due out in near future (early 2001)
Interdepartmental Committee on Intensive Animal Industries	1997	<i>The New South Wales feedlot manual (2nd edition)</i>			NSW Agriculture, Orange	NSW Agriculture	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Archer, C.	1997	<i>Total land use code of practice</i>	Booklet, 28 pp, colour photos	\$13.00	NSW Agriculture	NSW Agriculture	Shows how the issues of biodiversity, pollution and weed control, management of wetlands and waterways, and conservation of cultural heritage and landscape values are handled on a commercial sized property. Food for thought for owners of all agricultural land
Kruger, I. Taylor, G. Ferrier, M.	1995	<i>Australian Pig housing series: effluent at work</i>	211 p, black and white photos, illustrations	\$55.00	NSW Agriculture, Tamworth	NSW Agriculture Bookshop	Summarises the principles and processes involved in effluent management for piggeries in Australia. Book presents an overview of piggery development and environmental sustainability. Practical design methods and management options for effluent treatment and land application systems
	1997	<i>Nursery industry water management – best practice guidelines</i>	64	\$16.50	Nursery Industry Association of Australia, HRDC	Nursery Industry Association of Australia, PO Box 907 Epping NSW 2121 fax 02 9876 6360	The most recent best practice recommendations for water use and reuse and environmental management for container nurseries. Includes sprinkler selection and evaluation, drainage, recycling and chemical use.
Williams, A. Williams, J.	2000	<i>Australian Cotton Industry Best Management Practices Manual (second edition)</i>	Folder, 160 pages plus two tear off pads. Also includes an introductory booklet with a guide to using the manual	Free to cotton growers,	Cotton Research & Development Corporation, Narrabri, NSW	Cotton Research & Development Corporation, Narrabri NSW 2390 phone: (02) 6792 4088 fax: (02) 6792 4400 email: crdc@crdc.com.au	A manual to help cotton growers manage pesticides safely and responsibly. Contains a risk-assessment process, as well as best practice information on managing pesticides. Areas covered are: 1. Application of pesticides 2. Storage and handling of pesticides 3. Integrated pest management 4. Farm design and management 5. Farm Hygiene The manual also includes a separate 40 page introductory booklet with a guide to using a manual
Liverpool Plains Management Committee	2000	<i>Liverpool Plains Management Committee Investment Strategy'</i>			Liverpool Plains Land Management Committee Inc.	Liverpool Plains Land Management Committee Inc. PO Box Gunnedah 2340	
Tinning, G. Canruthers, G.	2002	<i>Environmental self-assessment guide for farmers in the northern grain region</i>			Total College, NSW Agriculture	Total College, NSW Agriculture	
Tinning, G. Canruthers, G.	2002	<i>Develop your own EMS – a grain farming example.</i>			Total College, NSW Agriculture	Total College, NSW Agriculture	
Daniels, I. Brown, R. Deegan, L. (eds)	1994	<i>SOILpak for northern wheat belt. A soil management package for dry land cropping in the summer rainfall zone</i>	4 ring folder – 6 sections, black and white photos, illustrations		NSW Agriculture	NSW Agriculture	
Mawhinney, W.	1998	<i>Land Use, Pesticide Use and their Impact on Water Quality on the Liverpool Plains</i>			Department of Land and Water Conservation	Department of Land and Water Conservation	
Kondinin	1999	<i>How to build a shed and store chemicals safely to meet safety regulations Farming Ahead November Number 95, p 40</i>			Kondinin Group	Kondinin Group	Practical advice on chemical shed construction and the relevant regulations in each state.
Peasley, D. Baker, J.	2001	<i>What good growers do: NSW's top banana growers share their secrets of success.</i>	Paperback, 29 pages, colour photos	\$25.00	NSW Banana Industry Committee	NSW Banana Industry Committee, PO Box 775, Murwillumbah, NSW 2484	Provides a series of 'top practices' recommended by leading growers. While many deal with production issues, several also have environmental implications such as use of groundcovers to prevent erosion, nutrient, irrigation and pest management.

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Ascroft, B. Hickey, M. Hoogers, R. Philpot, K. Hulme, 2002 J. Qassim, A.		<i>Best management guidelines for irrigation of carrots and onions.</i>	Paperback, 67 pages, colour photographs and graphs.	\$22.00	NSW Agriculture, Orange	NSW Agriculture, 161 Kite St, Orange, NSW, 2800	Booklet provides information specific to the management of irrigation practices for carrots and onions. Management issues (including off-farm impacts) are discussed, with recommendations made on a regional basis for best practices. Seven cases studies are provided to detail practices for particular areas.
Stirzaker, R. Vertessy, R. Sarre, A.. (eds.) 2002		<i>Trees, water and salt: An Australian guide to using trees for healthy catchments and productive farms.</i>	Paperback book, 159 pages, colour photographs, diagrams and graphs.	\$27.00	Rural Industries Research and Development Corporation	Rural Industries Research and Development Corporation, Level 1, AMA House, 42 Macquarie Street, BARTON ACT 2600, PO Box 4776, KINGSTON ACT 2604	The book examines the role of trees in the hydrological cycle, and their function in water balances within catchments. It examines the establishment of trees on farm and how agro forestry can be combined with agriculture. Balancing the health of catchments with farm productivity is also covered.
Williams, D. 2002		<i>Soil water monitoring: choosing the right advice</i>	Agfact	Free	NSW Agriculture, Orange	NSW Agriculture, http://www.agric.nsw.gov.au/reader/14841	This Agfact is for irrigators who choose a soil water monitoring device and like to understand what influences choice.
Greenslade, R. Williams, D. 2002		<i>Soil water monitoring: list of devices and distributors.</i>	Agfact	Free	NSW Agriculture, Orange	NSW Agriculture, http://www.agric.nsw.gov.au/reader/16149	This Agfact shows the range of soil moisture monitoring devices an irrigator can choose, their mode of operation and contact details for companies & suppliers who sell or provide advice on them.
Ang. Page 51 of 698		<i>Tensiometer Tips</i>	Brochure	Free	NSW Agriculture	NSW Agriculture, http://www.agric.nsw.gov.au/reader/3902	This brochure explains the preparation, installation and maintenance procedure of tensiometers, a soil moisture monitoring device.
Smith, P. Richards, A. 2003		<i>How much does it cost to pump?</i>	Agfact	Free	NSW Agriculture, Orange	NSW Agriculture, Windsor	This Agfact describes a simple procedure to work out the pumping costs for your electric pump.
Richards, A. Smith, P. 2003		<i>How efficient is your pump?</i>	Agfact	Free	NSW Agriculture, Orange	NSW Agriculture, Windsor	This Agfact describes a simple procedure to work out the efficiency of your electric pump. This should be read in conjunction with companion Agfact above (How much does it cost to pump?). When irrigators have determined their pump efficiency, you can compare it to the manufacturers figures to decide when to repair or replace.
	2002	<i>Why prepare an irrigation and drainage management plan.</i>		Free	NSW Agriculture	NSW Agriculture, http://www.agric.nsw.gov.au/reader/13607	This outlines what is an IDMP, how to get started and benefits of completing if on your property.
NSW Agriculture Water Wise Staff	2002	<i>IDMP Guidelines – how to prepare an irrigation & drainage management plan</i>	Guidelines	Free	NSW Agriculture, Orange	NSW Agriculture, Water Wise on the Farm Orange. http://www.agric.nsw.gov.au/reader/11267	These guidelines explain how to prepare an IDMP, and the technical content required in the 8 different sectors. This is the planning process for helping irrigators improve irrigation management and environmental performance.
Wedd, S. 2000		<i>An introduction to Irrigation Management Course</i>	Leaflet	Free	NSW Agriculture	NSW Agriculture, Windsor	This leaflet outlines what the WaterWise on the Farm program is, why it is important to improve irrigation management and an overview of the 4 day irrigation course offered by NSW Agriculture's Windsor staff.

Publications from Western Australia

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Agriculture Western Australia, Department of Environment Protection	1999	Codes of practice for vegetable production on the swan coastal plain (MP 37/99)			Agriculture Western Australia, South Perth	Agriculture Western Australia	
	2001	Environmental Code of Practice for Potato Growers				Agriculture Western Australia	Currently being finalised, should be able to be adapted for other forms of intensive horticulture It lists environmental principles and BMP information.
Latto, A. Noonan, J.D. Taylor, R.D.	1999	Environmental hazards of farming in Western Australia (Btin 4329)			Agriculture Western Australia, South Perth	Agriculture Western Australia	
Agriculture Western Australia	1999	Forage shrubs and grasslands for revegetating shrublands (Btin 4153 reviewed 1999)			Agriculture Western Australia, South Perth	Agriculture Western Australia	
Agriculture Western Australia		Managing dairy farm effluent (Btin 4336)			Agriculture Western Australia, South Perth	Agriculture Western Australia, available on line: www.agric.wa.gov.au/agency/Pubns/bulletin/bulletin4336/	These guidelines aim to assist dairy farmers plan effluent management systems which are practical, as well as easy to install and manage, while being acceptable to the Agencies and Authorities given the responsibility of protecting the environment
Agriculture Western Australia		Managing land degradation using land use planning processes – training resources manual (MP 63/99)		\$33.00	Agriculture Western Australia, South Perth	Agriculture Western Australia	
Agriculture Western Australia		Monitoring and managing soil acidity (Btin 4228)			Agriculture Western Australia, South Perth	Agriculture Western Australia	
		Natural resource management in Western Australia – catchment water management. Guidelines for those considering drainage for waterlogging and salinity management (Btin 4464)			Agriculture, Western Australia	Agriculture Western Australia	
Agriculture Western Australia	1999	No Till Essential Oct 99 (MP 52/99)			Agriculture Western Australia, South Perth	Agriculture Western Australia	
	1997	Preventing soil erosion and soil structure decline: a soil management practices guide for horticultural farmers in south-west high rainfall hills (MP 23/97)			Agriculture Western Australia, South Perth	Agriculture Western Australia	
Agriculture, Western Australia	1999	Reading the rangeland: a guide to the arid shrublands of western Australia		\$11.00	Agriculture Western Australia, South Perth	Agriculture Western Australia	
Agriculture Western Australia		Revegetation guide to the central wheatbelt (Btin 4231)		\$11.00	Agriculture Western Australia, South Perth	Agriculture Western Australia	
Barrett-Lennard, E.G. Malcolm, C.V.	1999	Saltland pastures in Australia : a practical guide (Btin 4312)		\$11.00	Agriculture Western Australia, South Perth	Agriculture Western Australia	
Moore, G.		Soil guide: handbook for managing and understanding agricultural soils (Btin 4343)		\$44.00	Agriculture Western Australia, South Perth	Agriculture Western Australia	
Butler, A.R.		The use of native perennial grasses on farms in the wheat belt of Western Australia (MP 8/99)			Agriculture Western Australia, South Perth	Agriculture Western Australia	
Dairy Industry Nutrient Strategy Working group	1998	Environmental Management for Animal Based Industries – Dairy Farm Effluent AgDex 410/27			Agriculture Western Australia, South Perth	Agriculture Western Australia	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Dalglish, N. Foale, M.	1998	Soil matters: monitoring soil water and nutrients in dry land farming	122 pp spiral bound, illustrations soft cover	\$33.00	Agricultural production Systems Research Unit, Toowoomba, CSIRO Australia, East Melbourne	CSIRO Publishing PO Box 1130 Collingwood, Vic 3066 ph: 03 9662 7500 fax: 03 9662 7555 URL: http://www.publish.csiro.au email: sales@publish.csiro.au	Soil Matters describes 'best practice' for those monitoring soils for water and nutrients. It should be used by farmers and consultants in the field, and is especially relevant to those wishing to apply their data to the APSIM crop simulation program. The use of APSIM can revolutionise the way farmers think about efficiencies in water and nutrient use and in strategies for risk management. Like any other computer simulation model, the output of APSIM depends greatly on the quality of information being applied. Soil Matters provides clear and well illustrated instructions on how to achieve the high-quality data needed. This manual is a starting point for the linkage between applied research and the needs of industry to make better use of our soil resources.
Glendinning, J.S.	1999	Australian Soil Fertility Manual (revised edition)	154 pp, illustrations	\$55.00	Fertiliser Industry Federation of Australia (inc) and CSIRO Australia	CSIRO Publishing	The manual aims to provide a working knowledge of agronomic terms, soil-plant relationships and principles of fertiliser use, in its broadest terms. It describes the types of agricultural soils, how they are classified and the interaction of soil, water and nutrients. It also provides an insight into how plants utilise nutrients and the role that individual nutrients play in the process of plant growth.
Lambert, M. Turner, J.	2000	Commercial forest plantations on saline lands Guidelines for riparian filter strips for Queensland irrigators. CSIRO Land and Water Technical Report **/99	39 pp, illustrations	\$108.90	CSIRO publishing, Melbourne	CSIRO Publishing	Provides information to allow users to work towards recovering salt-degraded land with plantation tree species
Kearney, L.E. Prosser, I.P.	1999	Managing waterlogged and saline catchments in south-west Victoria: a soil-landscape and vegetation key with on-farm management options.	spiral bound, 48 pp, illustrations	\$27.50	CSIRO publishing	CSIRO Publishing	These guidelines aim to provide a generic set of design procedures that can be used across Queensland for the purpose of designing filter strips to trap sediments and attached nutrients eroded from agricultural land.
Cooper, J. Fitzpatrick, R. Mintern, L. Bourne, J. Whipp, G.	1999	National guidelines for beef cattle feedlots in Australia. SCARM report no 47	47 p, illustrations	\$104.45	CSIRO Australia, Collingwood	CSIRO Publishing	The manual has been developed to enable farmers to compile a map of key soil features on their properties. With each colour identification soil profile is a checklist of suggested management practices which would enable the farmers to maintain or rehabilitate the soils. The manual will assist in increasing pasture productivity, biodiversity as well as, reducing rising waterables and associated waterlogging.
SCARM	1997	Soil analysis: interpretation manual	369 p, photos, illustrations	\$21.95	CSIRO, division of forestry	CSIRO Publishing	Guidelines provide framework of acceptable principles for the establishment and operation of feedlots. The guidelines cover consideration for site selection, design and construction, operation and management, monitoring and reporting as well as providing design specifications for feedlot drainage systems and areas for effluent and manure utilisation.
Peverill, K.J. Sparrow, L.A. Reuter, D.J. (ed)	1995	Trees for saltland: guide to selecting native species for Australia					The manual has been produced as a practical guide for users on what soil tests are, when they can be used reliably and consistently, and where lack of sound data limits their application. (Appears to be more aimed at soil and environmental scientists, farm advisers, consultants rather than farmers)

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Agriculture and Resource Management Council of Australia and New Zealand	1997	National Guidelines for beef cattle feedlots in Australia (2nd edition)	book 47 pp, illustrations		CSIRO, Collingwood, Vic	CSIRO Publishing	The intent of these guidelines is to provide a framework of acceptable principles for the establishment and management of feedlots in Australia. The requirements in the guidelines are acceptable standards for good management practice across Australia. issues covered in the guidelines include consideration for site selection, design and construction, operation and management, and monitoring and reporting. Design specifications are included for feedlot drainage systems and areas for effluent and manure utilisation. Animal welfare issues are also covered. It should be noted that individual State, Territory, regional and local government guidelines may be more detailed and/or stringent than these guidelines, to take account of specific circumstances in different geographic areas.
Fitzpatrick, R. Cox, J. Bourne, J.	1997	Managing water logged catchments on the Mount Lofty Ranges, South Australia	36 pages spiral bound, full colour plus laminated insert sheet	\$27.50	CSIRO Publishing	CSIRO Publishing	These guides will help quickly and cheaply locate existing and potential problem areas and decide on a plan of action. It identifies plant and soil features which indicate waterlogging and salinity in the high rainfall catchments of the Mt Lofty Ranges and advises on management options for improving productivity. Although they use regional information, the principles are generic and can be used in other catchments
Renegasamy, P. Bourne, J.	1997	Managing sodic, acidic and saline soils	16 pp full colour	\$11.00	CRC for soil and land management	CSIRO Publishing	Guide to diagnosing a topsoil or subsoil for acidity, salinity or acidity problems. It is illustrated to show the equipment and steps involved. The manual outlines remedial practices tailored to specific problems.

Publications from Tasmania

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
		A guide to riparian vegetation and its management		\$27.50		Department of Primary Industries, Water and Environment The Bookshop PO Box 46 Kings Meadow Tas 7249 phone (08) 6336 5444 fax: (08) 6344 4961	
		Codes of practice for dairy effluent and dairy shed premises				Department of Primary Industries, Water and Environment	
		Irrigation: getting it right				Department of Primary Industries, Water and Environment	
		Keeping your soil on your farm		\$5.50		Department of Primary Industries, Water and Environment	
		Managing Tasmania's cropping soils		\$11.00		Department of Primary Industries, Water and Environment	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
		Managing wet soils on your dairy farm				Department of Primary Industries, Water and Environment	
		Riparian land management technical guidelines		\$27.50		Department of Primary Industries, Water and Environment	
		Saltpak		\$110.00		Department of Primary Industries, Water and Environment	
		Sustainable management practices		\$ 11 each (x3), \$27.50 full set		Department of Primary Industries, Water and Environment	
		whole farm planning technical manual		\$16.50		Department of Primary Industries, Water and Environment	
		A code of practice for orchard spraying in Tasmania				Department of Primary Industries, Water and Environment	
Page 515 of 598 Kirby, J. Giffedder, L.	1999	Tasmanian bushcare toolkit: a guide to managing and conserving bushland on your property.			Department of Primary Industries, Water and Environment, Hobart Tasmania	Available on line at www.bushcare.tas.gov.au ?hardcopies	The Tasmanian Bushcare Toolkit has been developed to enable farmers to assess the native bush on their property and develop strategies to manage it into the future. It is made up of nine kits: 1. Bush on your farm 2. Managing your bush 3. Weeds in your bush 4. Revegetating your farm 5. Threatened plant species in your bush 6. Riparian bush 7. Grassy bush 8. Eucalypt bush 9. Other bush types
Thompson, B.	1997	Managing Dairy Effluent in Tasmania			Tasmanian Dairy Effluent Working Group	Tasmanian Farmers and Graziers Association	

Publications from Victoria

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Anderson, G. McKenzie, M. Wightman, B.	1999	Best practice for raised bed controlled cropping			DNRE, Geelong	Natural Resources and Environment Information Centre GPO Box 500 East Melbourne, Vic phone: (03) 9637 8325 fax: (03) 9637 8150 email: publication.sales@nre.vic.gov.au	
McCarthy, M. Staplyton, P.		Better pastures better crops – pastures for cropping/livestock farms		\$16.50		Natural Resources and Environment	
Boland, A.	2000	BMP for water management of stone and pome fruits			Natural Resources and Environment, East Melbourne, Victoria	Natural Resources and Environment	
Jones, L.D. Patto, M.	1999	Border check irrigation design guidelines		\$33.00	Irrigation Association of Australia, Adelaide	Natural Resources and Environment	Draws together design practices for border check irrigation (flood and gravity) from all parts of Australia
Streerer, B.		Bringing back the wetland		\$22.00		Natural Resources and Environment	Required reading for ecologists, managers and conservationists
Page Chemical Standards Branch	1999	Code of practice for farm chemical spray application	47 pp		Natural Resources and Environment, East Melbourne, Victoria	Natural Resources and Environment	The purposes of this code is to provide a standard for the safe and effective application of farm chemicals. It highlights the user's responsibility to ensure that spray application and farm chemicals do not move beyond the target area.
JVAP Program		Design principles for farm forestry and trees on farms		\$17.60		Natural Resources and Environment	
Watts, P. Tuckker, R.		Designing better feedlots		\$82.50		Natural Resources and Environment	This book will benefit lofeeders and people thinking about starting a lot feeding enterprise
NRE		Environment handbook (soft cover)		\$38.45		Natural Resources and Environment	
		Fertilising dairy pastures (part target 10 project)		\$71.50		Natural Resources and Environment	
Davidson, D.		Guide to growing wine grapes in Australia (2nd edition)		\$35.20		Natural Resources and Environment	
Harris, R. Ridley, A.	2000	How to minimise nitrogen and phosphorous losses from temperate dry land grazing and cropping farms – nutrient management guidelines.	35 pp, black and white photos white photos illustrations		Department of Natural Resources and Environment, Victoria (Rutherglen)	Natural Resources and Environment	This report provides catchment and extension providers with strategies on how to keep nutrients on the farm. It describes Current Recommended Practice (CRP) as well as covering the theory behind nutrient loss from dry land grazing and cropping farming systems.
Matheson, B.	1996	Land care: rural property planning		\$38.45	Inkata press, Melbourne	Natural Resources and Environment	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Reid, R.		Making farm trees pay: the role of trees in sustainable agriculture		\$8.80		Natural Resources and Environment	
Noble et al		Mallee lands: conservation perspective		\$71.50		Natural Resources and Environment	
Mickan, F.	1996	Management options on wet soils	30pp	\$11.00	Agriculture Victoria, Ellinbank, Vic	Natural Resources and Environment	
Monks, L. (ed)		Managing dairy shed wastes (vol 1)		\$21.95		Natural Resources and Environment	
Monks, L. (ed)		Managing dairy shed wastes (vol 2)		\$32.95		Natural Resources and Environment	
Ridley, A. Paramore, T. Froelich, V. Beverly, C. Seymour, E.	2002	Riverina Environmental Management System (EMS) Package	Package		DNRE, Rutherglen Vic	Natural Resources and Environment	Package provides a self-awareness tool for farmers to develop the understanding of environmental issues that may occur on farm. The package does not cover all aspects of an EMS, but will assist farmers with some EMS development.
Mitchell, P. Goodwin, I.	1996	Micro-irrigation of vine and fruit trees	175 pp, illustrations	\$38.45	Agmedia, East Melbourne, Victoria	Natural Resources and Environment	The book is divided into two parts. Part 1 covers the theory of micro-irrigation, while Part 2 covers the practice. In Part 1 authors Mitchell and Goodwin explain how and why micro-irrigation differs from other types of irrigation, why micro-irrigation techniques differ between localities, and how micro-irrigation can be used to manipulate plant growth and yield. In Part 2 they cover choosing, designing, installing, and operating a micro-irrigation system. They discuss pump and filter selection, and methods of frost control using micro – irrigation. The information presented in this book will equip readers with sufficient knowledge to enable them to choose, design and install micro-irrigation.
Nash, D.	2000	Minimising direct losses of fertiliser phosphorous from agricultural land		\$10.00		Natural Resources and Environment	
Kolpak, L.O.		Modern techniques in water and wastewater management		\$87.95		Natural Resources and Environment	
Cumow, B. Chaffey, B.		pasture improvement in Victoria: principles of sustainable agriculture		\$10.95		Natural Resources and Environment	
Bickford, R.	1995	Pasture management. Practical farming series		\$38.45	Inkata Press, Sydney	Natural Resources and Environment	
Romanowski, N.	1998	Planting wetlands and dams: a practical guide to wetland design	108 pp, colour illustrations	\$25.25	University of NSW Press, Kensington	Natural Resources and Environment	A practical design to wetland, design, constructions and propagation. It covers modification and improvement of dams, species selection, plant propagation and establishment, exotic weeds and a detailed list of wetland plants.
Baydack et al	1999	Practical approaches to the conservation of biodiversity		\$88.15		Natural Resources and Environment	This work brings together a range of scientific and management approaches and provides guidelines for conserving biodiversity
Cornforth, I.		Practical soil management		\$43.95		Natural Resources and Environment	
Norman, C. McDonald, P. Grogan, A.	1995	Salt kit: a 'do it yourself' salinity identification kit for farmers of Northern Victorian Irrigation Region	4 ring folder, colour photos, illustrations		Agriculture Victoria, Tatura	Natural Resources and Environment	Aims to enable farmers to identify salinity problems on their farms. It includes general description of visual soil and plant symptoms related to salinity, sodicity and waterlogging. Provides instructions on how to install a testwell, and how to collect and test soils and water samples
Happs & Kinnear		Soil degradation: an Australian perspective		\$22.00		Natural Resources and Environment	
Agriturf Research Institute		Soil manual		\$34.65		Natural Resources and Environment	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Reilly, L., Marshall, D. Carini, A. (eds.)	1995	Spotting soil salting: Victorian field guide to salt indicator plants	90 pp, colour photographs and distribution maps.	\$7.70	Natural Resources and Environment, Victoria	Natural Resources and Environment	The publication provides key visual indicators that may indicate the early signs of soil salting. Plant species tolerant of soil salting (and thus serving as indicators) are shown, together with a general and more detailed description, typical soil requirements, habitats and notes. A salinity tolerance rating is provided for each species. A glossary and diagrams showing various taxonomic features is also provided. The book is spiral bound and will easily fit in a glove box, or pocket.
Krause, M. Richardson, J.		Sustainable farming enterprises: rural property planning		\$38.45		Natural Resources and Environment	
Hollier, C.	1999	The Acid Soil Action Toolkit			DNRE, Rutherglen	Natural Resources and Environment	
Morley, T. Staplyton, P.	1999	The Paterson's Curse management handbook	40pp, colour photos, illustrations	\$10.00	Natural Resources and Environment, East Melbourne, Victoria	Natural Resources and Environment	Handbook intended to provide information on the distribution, biology, management options and control techniques for Paterson's curse. Detailed advice is provided to enable the Paterson's curse problem to be assessed and to determine priorities for control activities. Control techniques discussed include cultural, chemical and biological control as well as subsequent pastures rehabilitation.
Department Agriculture Victoria		Victorian code of practice for Cattle feedlots- August 1995		\$16.50		Natural Resources and Environment	
Glastone, J.		Viticulture and environment		\$66.00		Natural Resources and Environment	
Beagood, W.		Weed management tools for an integrated approach		\$12.95		Natural Resources and Environment	
Godwin, I.		A grape growers guide to irrigation scheduling and regulated deficit irrigation		\$16.50	Institute of sustainable agriculture, Tatura, Victoria	Natural Resources and Environment	
Mills, S.		Managing Nutrients on Irrigated dairy farms			Goulburn Broken River Environment and Water Quality Committee		
Waters, C.		Planning Your Dairy Farm – Ideas and Considerations			Natural Resources and Environment	Natural Resources and Environment	
Waters, C.		Managing Dairy Shed Wastes in High Rainfall Areas			Natural Resources and Environment	Natural Resources and Environment	
Waters, C.		Conserving Soils on Dairy Farms in High Rainfall Areas			Natural Resources and Environment	Natural Resources and Environment	
Crocos, A.	1995	Dairy Waste: Management of Dairy Shed Waste in Victoria			Agriculture Victoria	Natural Resources and Environment	
Wheeler, J.	1995	Dairy Waste: Application to Pastures			Agriculture Victoria	Natural Resources and Environment	
Hopkins, D.	1995	Dairy Waste: Minimising Dairy Shed Waste			Agriculture Victoria	Natural Resources and Environment	
Corbett, J.	1995	Dairy Waste: Choosing a Pondage System			Agriculture Victoria	Natural Resources and Environment	

Publications from South Australia

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Southern, N.	1997	Farm irrigation – planning and management		\$38.45	Inkata Press, Port Melbourne	PIRSA + others?	
PIRSA		Conservation cropping practices	32p	\$11.00		Primary Industries and Resources South Australia	
PIRSA		Fertiliser handbook	88p	\$36.85		Primary Industries and Resources South Australia	
PIRSA		Floodplain management in Australia	23p	\$38.50		Primary Industries and Resources South Australia	
		Intelligent irrigation	31p	\$1.65		Primary Industries and Resources South Australia	
Skewes, M. Meissner, T.	1997	Irrigation benchmarks and BMP for citrus		\$13.20	Primary Industries and Resources South Australia, Adelaide	Primary Industries and Resources South Australia	
Skewes, M. Meissner, T.	1998	Irrigation benchmarks and BMP for potatoes		\$13.20	Primary Industries and Resources South Australia, Adelaide	Primary Industries and Resources South Australia	
Skewes, M. Meissner, T.	1998	Irrigation benchmarks and BMP for wine grapes		\$13.20	Primary Industries and Resources South Australia, Adelaide	Primary Industries and Resources South Australia	
Skewes, M. Meissner, T.	1998	Irrigation vineyards	56p	\$16.50		Primary Industries and Resources South Australia	
Holler et al		Monitoring and managing acidic soils		\$11.00		Primary Industries and Resources South Australia	
PIRSA		Principles of sustainable agriculture		\$13.50		Primary Industries and Resources South Australia	
PIRSA		Reduced tillage	165p	\$5.50		Primary Industries and Resources South Australia	
PIRSA		Soils and fertilisers exposed	106p	\$17.60		Primary Industries and Resources South Australia	
PIRSA		The occurrence and management of acid soils in SA	15 pp	\$5.50		Primary Industries and Resources South Australia	
Rengasamy, P. Boume, J.	1997	Managing sodic, acidic and saline soils	16 pp full colour	\$11.00	CRC for soil and land management	Primary Industries and Resources South Australia	Guide to diagnosing a topsoil or subsoil for acidity, salinity or acidity problems. It is illustrated to show the equipment and steps involved. The manual outlines remedial practices tailored to specific problems.
SA Dairy Effluent Guidelines Group	1997	South Australian Dairy Effluent Guidelines			SA Dept. Environment and Natural Resources		

Publications from Queensland

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
QDNR		Conservation grazing management		\$16.50	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources Service Centre GPO Box 2545 Brisbane Qld 4001	
		Native vegetation management in Queensland – book		\$25.00		Department of Natural Resources	
		Native vegetation management in Queensland – CD		\$10.00		Department of Natural Resources	
Smith, M. ed	1999	Natural resource monitoring guide: a practical guide for detecting changes occurring at the property of catchment level	154 pp spiral bound, colour photos	\$16.50	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	The guide aims to provide landholders with some simple, efficient and effective techniques for monitoring resource condition. These techniques can be used by landholders to evaluate and record changes occurring on their land overtime. Assessment techniques are described for : soil and land processes, native vegetation and wildlife, pest animals and plants, pasture condition and state of watercourses and water quality.
QDNR		Options for stabilisation of soil erosion on arable soils in the central highlands		\$16.50	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
QDNR		Practical aspects of planning and implementing strip cropping systems on a very low gradient land		\$16.50	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
QDNR		Salinity management handbook		\$33.00	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
		Understanding and managing acid sulfate soil canelands		\$11.00	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
		Understanding and managing Burdekin soils		\$33.00	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
		Understanding and managing soils in the central highlands, field manual		\$55.00	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
		Understanding and managing soils in the Moreton region, field manual		\$55.00	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
		Understanding and managing soils in the Murilla, Tara and Chinchilla shires		\$55.00	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
QDNR		Understanding and managing soils in the Stanthorpe – Rosenthal region, field manual		\$66.00	Department of Natural Resources, Brisbane, Queensland	Department of Natural Resources	
		A review of strip cropping practices on the eastern darling downs		\$27.50		Department of Natural Resources	
Tapsall, S. Beumer, J. Couchman, D. Marchasy, J.	2000	Cane growers on-farm maintenance of plants with marine plants: fish habitat code of practice for use with strategic permits issued under Section 51 of the Fisheries Act 1994	30 pp		Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	The code of practice has been developed to address the requirements of the Fisheries Act 1994; (Qld) for the statutory protection of fish habitats and marine plants on cane farms.
		Dairy Industry environmental code of practice – draft				Department of Primary Industries	Document is intended to provide a technically sound, consistent set of operational standards to enable the dairy industry to develop and operate in an economically viable and environmental sustainable manner. It will also assist dairy operators, developers and consultants in planning and operating dairies. Jim Fletcher (fletcherj@dpi.qld.gov.au)
QDPI	1996	Dairy processors; managing environmental risks	57 pp, illustrations. Soft cover	\$25.00	Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	Replaced by COP.
Page 52 of 698 And 698	2001	Environmental Code of practice for Queensland piggeries	115 p	\$44.00	Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	Covers developing and operating piggeries in an environmentally sustainable manner, including legislative requirements, planning and site selection, management guidelines along the waste stream from waste generation to waste utilisation, carcass disposal, storm water management, community amenity and environmental management plans
Harris, P. Gray, J.	1996	Making better decisions for your property	62 pp 3-ring binder	\$22.00	Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	
QDPI	1998	Monitoring grazing lands in northern Australia	98pp softcover	\$25.00		Department of Primary Industries	
Spooner, N.	2000	Parthenium Weed: best management practice	26 pp, colour photos		The State of Queensland, Department of Primary Industries and the Parthenium Weed Action Group inc	Department of Primary Industries	This booklet outlines principles of Parthenium weed management. It includes precautions that can be undertaken to prevent Parthenium weed establishment, and also managing pastures to suppress Parthenium weed. Information is also included on the biological control agents and herbicides that can be used to control Parthenium weed.

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
QDPI	2000	PRIME Notes (version 9) on CD-ROM	200g Mac-IBM compatible 486 or higher/CD-drive & windows 95 or later	\$45.00	Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	PRIME NOTES on CD-ROM offers over 3969 fact sheets with full text and graphics on many aspects of primary industries: from conservation cropping to crop management to weeds. DPI Notes, DNR Facts, NRE Notes, PIRSA Fact Sheets, GRDC Project Summaries, Machinery Evaluation Notes & Research Reports by Kondinin Group, TBC Fact Sheets, BSES Fact Sheets, Agnotes & Agfacts by NSW Agric. Farmnotes by Agriculture WA, Agnotes by DPIE NT. PRIME NOTES (Version 9) on CD ROM gives you many advantages such as: rapid retrieval of information, full text index searching, and descriptive graphics. Farmers and graziers, agricultural consultants, extension officers, land managers, teachers and students, and all users of Government agricultural advisory services will find this an invaluable source of information.
Wyle, P. Page 522 of 698	1996	Profitable Landcare – sustainable farming in summer rainfall areas	148 pp, black and white photos	\$27.50	Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	This book examines the problems and practices of farming and looks at how it can be made more sustainable. It outlines concepts of sustainability – farm profits, soil stability and a healthy environment – and looks at what a farmer can do to achieve these. Issues covered include soil structure, erosion and fertility, degradation (salinity, sodicity and acidity), soil biota, weeds, and pests and diseases. The book will be most useful in farming areas which have both summer and winter rainfall and grow cereals such as wheat, barley, sorghum, and associated crops such as grain legumes, oilseeds and cotton. This book should prove invaluable to farmers in these regions or anyone else interested in the issues related to sustainable farming.
Skerman, A.	2000	Reference manual for the establishment and operation of beef cattle feedlots in Queensland	4 ring folder – 13 sections, illustrations	\$60.50	Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	The aim of this manual is to promote the development and operation of cattle feedlots in accordance with the principles of ecologically sustainable development. The manual will assist feedlot developers in the planning and design of new feedlots, and assist existing feedlot operators in implementing improved operation and management procedures and methods. Focuses on the soils, climate and crops of the summer rainfall cereal lands of Queensland and northern NSW. It details the various degradation processes and examines farming systems in terms of sustainability. Principles of sustainability are thus established and these are well illustrated by examples from practical regional agriculture. The pathway to sustainable agriculture is clearly indicated
Clarke, A.L. Wylie, P.B.	1997	Sustainable crop production in the sub- tropics: an Australian perspective	376 pp, colour illustrations (?photos) yet to view book	\$104.50	Department of Primary Industries, Brisbane, Queensland	Department of Primary Industries	Code of practice was developed by CANEGROWERS with the involvement of individual canegrowers, the Department of Environment, the Bureau of Sugar Experiment Stations and the Cooperative Research Centre for Sustainable Sugar Production. The code aims to explain in cane growing terms what are reasonable and practicable measures to minimise the risk of harm to the environment. The code provides guide lines for developing new land as well as established farms. Issues covered include farm plans, acid sulfate soils, wetlands, soil management, native vegetation management, irrigation, weed, pest & disease control.
Canegrowers	1998	Code of practice: sustainable cane growing in Queensland	27 pp, illustrations		Canegrowers GPO Box 1032 Brisbane 4001 ph: (07) 3864 6444 fax: (07) 3864 6429 e-mail:	Canegrowers? GPO Box 1032 Brisbane 4001 ph: (07) 3864 6444 fax: (07) 3864 6429 e-mail:	

Comment
(paragraph which outlines type of information contained in the document)

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Canegrowers		Riparian management. Is there a rat in your hip pocket – rat control and 19 other good reasons to revegetate	12 pp, colour photos, illustrations		CANEGROWERS	Canegrowers GPO Box 1032 Brisbane 4001 ph: (07) 3864 6444 fax: (07) 3864 6429 e-mail:	Outlines benefits of maintaining native vegetation on water ways associated with cane farms. It also provides principles/ guidelines for revegetating along these water ways. Probably not enough detail
Queensland Farmers' Federation	1998	Code of Practice for Agriculture	30 pp		Queensland Farmer's Federation	Queensland Farmers' Federation 27 Peel St South Brisbane Qld 4101 ph 07 3844 7261 fax 07 3844 7303 URL www.qff.org.au then follow links to policy	The Environmental protection Act places responsibility on all Queenslanders to meet a General Environmental duty of care. The Queensland Farmers' Federation Code of Practice is a legal document approved under the Act, which states ways for producers to achieve compliance with the General Environmental Duty.
Qld Fruit & Vegetable Growers	1998	Farmcare Cultivating a Better Future – Code of Practice for Sustainable Fruit and Vegetable Production in Queensland	92 pp, colour photos and illustrations		Queensland Fruit and Vegetable Growers, Brisbane Queensland Australia Tel: 61 7 3213 2444 Fax: 61 7 3213 2480 Email: qfvg@qfvg.org.au	Queensland Fruit and Vegetable Growers Ltd PO Box 19 Brisbane Market QLD 4106 Tel: 61 7 3213 2444 Fax: 61 7 3213 2480 Email: qfvg@qfvg.org.au	
QDNRM Page 529 of 698	1997	Planning guidelines – Separating Agricultural and Residential Land Uses			DNRM		
Anon		Primenotes CD-ROM	Version 14	Ring 1800 816541 for	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816541	
Anon		Acid Sulfate Soils in Queensland	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816542	
Anon		Identifying Acid Sulfate Soils	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816543	
Anon		Managing Acid Sulfate Soils	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816544	
Anon		Using Acid Sulfate Soils Maps	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816545	
Anon		HOWWET? – estimating soil moisture and nitrogen	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816546	
Anon		Managing soil cover – brigalow soils of Dawson/Callide	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816547	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
Anon		Soil compaction in cropping lands	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816548	
Anon		The HOWOFTEN? Computer program – Probabilities for daily rainfall records	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816549	
Anon		Tillage decisions for better water storage	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816550	
Anon		Erosion control in cropping lands	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816551	
Anon		Farm access tracks for erosion control	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816552	
Anon		Gully Erosion	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816553	
Anon		Land conservation – runoff control measures	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816554	
Anon		Monlo velvet grass for soil and water conservation	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816555	
Anon		Erosion control of grazing lands	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816556	
Anon		Land management strategies for drought on grazing land	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816557	
Anon		Buffer areas – Minimising conflict between agricultural and residential areas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816558	
Anon		Property plans – When should they be prepared?	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816559	
Anon		Protecting agricultural land from urban development	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816560	

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(paragraph which outlines type of information contained in the document)

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Anon		Soil conservation planning in cropping lands	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816561	
Anon		Land Management plans for taxation purposes	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816562	
Anon		Loans for Landcare	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816563	
Anon		A guide to property mapping	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816564	
Anon		Choosing a property map	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816565	
Anon		Computer based property mapping and recording	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816566	
Anon		Property mapping – Adding information	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816567	
Anon		Property mapping – Measuring distances and areas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816568	
Anon		Property mapping – Useful sources of information	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816569	
Anon		Using topographic maps	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816570	
Anon		Identifying and monitoring salt affected areas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816571	
Anon		Managing dryland salinity on your property	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816572	
Anon		Managing salinity with engineering	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816573	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
Anon		Managing salinity with vegetation	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816574	
Anon		Production from salty lands	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816575	
Anon		Understanding soil	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816576	
Anon		Understanding soil pH	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816577	
Anon		Erosion control for bananas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816578	
Anon		Control of feral pigs	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816579	
Anon		Feral cat ecology and control	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816580	
Anon		Feral pigs in Qld – distribution, ecology and impact	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816581	
Anon		Pest animal management in settled areas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816582	
Anon		How healthy is your watercourse?	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816583	
Anon		Managing stock in and around waterways	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816584	
Anon		Stream bank planting guidelines and hints	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816585	
Anon		Stream bank vegetation is valuable	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816586	

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(paragraph which outlines type of information contained in the document)

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment
Anon		What causes bank erosion	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816587	
Anon		What causes stream bed erosion	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816588	
Anon		Growing rainforest cabinet timbers in Queensland	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816589	
Anon		Timber production on farms	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816590	
Anon		Windbreaks	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816591	
Anon		Resources for trees on farms	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816592	
Anon		Catering for wildlife	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816593	
Anon		Corridors and clumps of native vegetation	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816594	
Anon		Fire management for protecting vegetation	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816595	
Anon		Managing native fodder trees	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816596	
Anon		Managing regrowth vegetation	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816597	
Anon		Native vegetation – monitoring mapping & conservation	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816598	
Anon		Property vegetation management planning on freehold land	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816599	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
Anon		Regional vegetation management planning	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816600	
Anon		Vegetation retention	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816601	
Anon		Establishing plants in dry areas or with limited water	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816602	
Anon		Establishing plants in frost prone areas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816603	
Anon		Fertilising native plants	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816604	
Anon		Weed control for successful plant establishment	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816605	
Anon		Plants suitable for heavy clay soils	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816606	
Anon		Plants suitable for low rainfall areas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816607	
Anon		Plants suitable for salty soils	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816608	
Anon		Plants suitable for sandstone or shale areas	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816609	
Anon		Shade in stockyards	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816610	
Anon		Shade trees for livestock	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816611	
Anon		Trees attractive for birds	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816612	

Anon		Direct seeding	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816613	
Anon		Enrichment planting	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816614	
Anon		Fencing vegetation	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816615	
Anon		Natural regeneration	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816616	
Anon		Propagation of native plants from seed	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816617	
Anon		Seed collection storage and testing	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816618	
Anon		Farm dam construction	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816619	
Anon		Farm dams – basic soil tests	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816620	
Anon		Planning your farm dam	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816621	
Anon		Using chemicals in water bores	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816622	
Anon		Water requirements for trees	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816623	
Anon		Land and water management plans	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816624	
Anon		The hydrologic cycle	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816625	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
Anon		Water resource planning	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816626	
Anon		Catchments and water quality	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816627	
Anon		Farm dams – how to improve water quality	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816628	
Anon		Irrigation water quality – salinity and soil structure stability	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816629	
Anon		Sampling your water supply	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816630	
Anon		Blue-green algae – General Information	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816631	
Anon		Managing blue-green algae blooms in farm dams	NRM Fact Sheet	Free	Department of Natural Resources and Mines (NR & M)	Department of Natural Resources and Mines www.nrm.qld.gov.au Phone: 1800 816632	
Stewart, G.D.	1998	The Environmental Protection Act (1994), Codes of Environmental Practice, and the Queensland Farmer	Proceedings				
Waters, W. Swan, G.	1995	Irrigation for Dairying			QDPI	QDPI	
Davison, T. Andrews, J.	1997	Feed Pads Down Under AgDex: 415/10 2nd Edition			QDPI	QDPI	
French, G.C.	1996	Environmental Guidelines for Queensland Dairy Farmers			QDPI	QDPI	
Streeten, T.A McGahan, E.	2000	Environmental Code of Practice for Queensland Piggeries			QDPI	QDPI	
Skerman, A..	2000	Reference Manual for the Establishment of Beef Cattle Feedlots in Queensland			QDPI	QDPI	
Stewart, D.	1999	Review of Dairy Effluent Guidelines in Australia	DRDC Project DAQ176		QDPI	QDPI	

Author	Date	Title	Product Type	Cost	Publisher	Available from	Comment (paragraph which outlines type of information contained in the document)
Wilshire, B.	1999	Fallow Weed Management Guide		\$22.70	QDPI	QDPI	The Fallow Weed Management Guide is the culmination of industry efforts to discuss the change of weed spectrum under minimum and zero till management. The guide has been produced in a user friendly way for farmers, agronomists and service providers. The Fallow Weed Management Guide provides a table of the latest chemical registrations, product label data and a weed glossary. The booklet goes on to discuss chemical resistance, spray drift, surfactants and tank mixing compatibilities, followed by farmer testimonials.
Lewis, B.	2002	Farm Dams – Planning, construction and maintenance	Soft cover	\$51.60	QDPI	QDPI	Farm Dams: Planning, Construction and Maintenance has been written to provide a practical approach and guide to determining catchment yield and the amount of water required in a dam, advising on selecting and working with engineers and contractors, as well as outlining the causes of dam failures and how to remedy problems quickly. It also covers relevant legislation, environmental and ecological issues.
Ross, H.	1990	Irrigation for profit – Water force Queensland		\$22.70	QDPI	QDPI	This book lays the groundwork for profitable irrigation and develops an action plan for confident and sustained effort. The chapters cover: getting started; soil management for irrigated agriculture; water management; breeding, seeding, and feeding; plant protection; watch that crop; economics of irrigated agriculture; beyond the farm gate; and putting water force into action.

Publications from South CRCWMS

Author	Date	Title	Product Type (number pp, whether it includes photos /illustrations)	Cost	Publisher	Available from (organisation and contact details)	Comment (paragraph which outlines type of information contained in the document)
Taylor, U. Sindel, B.	2000	The pasture weed management kit: a guide to managing weeds in southern Australian perennial pastures	58 pp, photos	\$10.00	Cooperative Research Centre for Weed Management Systems	CRC for Weed Management Systems PMB 1, Glen Osmond, SA 5064 ph: 08 8303 6590 fax: 08 8303 7125 e-mail: crcweeds@waite. adelaide.edu.au WWW:http://www. adelaide.edu.au/ CRCWMS	Weed management kit has been designed to provide practical tips for weed management in pasture systems. The kit is divided into two parts. Part 1 provides a good grounding in the principles of weed control in pastures, particularly through pasture management and the encouragement of desirable perennial pastures. The information presented is applicable to all weeds in a general sense. Part 2 provides detailed information on the management of ten of the high priority pasture weeds (Bathurst Burr, Blackberry, Nodding Thistle, Paterson's Curse, Saffron Thistle, Serrated Tussock, Scotch Thistle, Illyrian Thistle, St John's Wort and Vulva) Provides an overview of techniques that can be used to manage wild oats. Growers are encouraged to think about their wild oat problem, decide whether they want to live with it or active long-term control, then develop an appropriate management plan for their farm. Cultural (hygiene, delayed seeding, crop competition, fertiliser use and placement, crop and pasture rotation, silage and green manuring), chemical control, allelopathic and biological control methods are covered
Nungent, T. Storie, A. Medd, R. Timmins, T.	1999	Managing wild oats	28 pp, colour photos, illustrations	\$10.00	CRC for weed management systems and GRDC	Cooperative Research Centre for Weed Management Systems	Handbook provides farmers across southern Australia with information on the biology and ecology of wild radish, its importance and management options. It focuses on incorporating weed management into the whole farm management plan. Includes farmer case studies
Nungent, T.	1998	Managing wild radish (<i>Raphanus raphanistrum</i>)	24	\$10.00	Cooperative Research Centre for Weed Management Systems	Cooperative Research Centre for Weed Management Systems	Provides contact details for over 1200 organisations and individuals who are involved in, or have an interest in, agricultural and environmental weed issues in Australia and New Zealand. The Weed Navigator: resource guide complements this directory.
Blood, K. Taylor, U. Nungent, T. Timmins, T.	1998	Weed navigator: contact directory	75 pp		Cooperative Research Centre for Weed Management Systems	Cooperative Research Centre for Weed Management Systems	Provides a comprehensive guide to information currently available on environmental and agricultural weeds in Australia and New Zealand. The guide lists and describes over 1980 books, publications, brochures, web sites, databases, CD- ROMs, strategies, training opportunities and much more.
Blood, K. Taylor, U. Nungent, T.	1998	Weed navigator: resource guide	96 pp		Cooperative Research Centre for Weed Management Systems	Cooperative Research Centre for Weed Management Systems	

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Carruthers, G & Tinning, G 1999, *Environmental Management Systems in Agriculture: Proceedings of a National Workshop, May 26-28, 1999*, Publication No. 99/94, Rural Industries Research and Development Corporation, Canberra.

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Publication 3: Where, and how, do sustainability indicators fit into environmental management systems?

Carruthers, G and Tinning, G (2003) Where, and how, do sustainability indicators fit into environmental management systems? *Australian Journal of Experimental Agriculture* 43(3): 307-323. <http://www.publish.csiro.au/paper/EA00177.htm> .
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Publication 3 was developed from research conducted with the grains industry in NSW and Queensland. This Grains Research and Development Corporation funded project was the first project in Australia (and we believe in the world) that sought to examine whether the EMS process as described by ISO 14001 could actually be applied to the farming context. Gavin Tinning and I worked together to develop EMSs with grain farmers (some of who also had livestock) on the Liverpool Plains in NSW and in the Theodore/Duaringa area in Queensland. My role in this work was the project leader and principal researcher, and I wrote the majority of the paper (90%) with Gavin reviewing and commenting on the paper (10%) in its later stages.

At the time we were working on the grains project, concerns were being raised by some agency staff, conservation groups and other non-government organisations that businesses (including farmers) would use EMS as a 'greenwash' exercise. It was suggested that managers would rely on the credibility generated by the use of international Standards such as ISO 14001 to avoid actually having to produce environmental outcomes as a result of management practice changes. In part, the belief arose because the ISO 14001 Standard does not specify exact outcomes to be achieved, other than the development of procedures and processes to deliver management actions. At the same time, farmers were telling us that they were being inundated by an ever-burgeoning proliferation of 'sustainability indicators'. These indicators were often developed in isolation from those managers expected to measure them, yet increased policy pressure was being applied for farmers to routinely monitor numerous issues that provided no useful data for their individual, specific farm management. This paper was therefore developed to examine if the

EMS process could help farmers identify and direct appropriate indicators, assist them to select indicators best suited to their needs, and to begin to develop the data needed to drive the continuous improvement of their farm management.

This paper is located at this point in the thesis because it is evident that to encourage adoption, clear benefits from the implementation of EMS need to be demonstrated. In order to do this, the ability to capture, measure, and report is important, and so a consideration of sustainability indicators and their relationship to EMS was warranted.

The important contribution of the paper is to highlight the effectiveness of the EMS process as a tool to determine directions for management, direct efforts to assess risks, to measure outcomes and emphasise how data-driven outcomes of EMS can feed back into both management and improved policy. The paper is also important as it helped to allay fears that EMSs could be applied without the expectation and anticipation of measurable outcomes being achieved.

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Publication 3: Carruthers, G. and Tinning, G. (2003) 'Where, and how, do sustainability indicators fit into environmental management systems'. *Australian Journal of Experimental Agriculture*, 43(3), 307-323.

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Publication 4: Using the EMS process as an integrative farm management tool

Carruthers G 2007. Using the EMS process as an integrative farm management tool. *Australian Journal of Experimental Agriculture*, 47(3): 312-324.

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Publication 4 presents the results of a dairy industry pilot study, one of 16 projects funded by the then Federal Department of Agriculture, Forestry, and Fisheries Australia (AFFA). This work examined the potential of the EMS process as a management tool to address the multiple drivers, demands, and constraints faced by dairy farmers. At the time the dairy industry was still adjusting to industry deregulation, and in many areas, dealing with a severe, on-going drought. Also, the reorganisation of catchment management authorities, with an emerging focus on tying funding to a demonstration of how farming activities were assisting in achieving catchment goals, meant that farmers were seeking management solutions that provided flexibility, proof of outcomes and that met the full gamut of management considerations (environmental, quality and social).

I gained the funding for this work, was the project manager, supervised five staff over the life of the project, worked with the farmers, wrote all associated reports and collected, analysed and wrote up the project information. In addition to the paper presented here, I was also the senior author (with Gavin Tinning) of a final report to AFFA published by NSW DPI.

This publication appears at this point in the thesis because it represents the evolution in my perception about the utility of the EMS process. In advance of many of the other EMS Pilot projects, and largely due to my previous case study research, I was not simply testing whether the concept of EMS could be used in the farming context. I had already seen how successfully this could occur. Instead, I was interested in an expansion of the thinking about EMS from simply being an environmental process

(with the emphasis on the 'Ems'), to being a management process (with the focus on the eMs). Additionally, because of my focus on the use of standards for management, this project allowed me to assess whether other management standards – namely those to do with quality assurance (ISO 9001) and occupational health and safety (AS 4801) – that could conceivably be brought to bear on farmers could be successfully integrated in the farm context. Farmers needed to be able to realise benefits from such an approach, and so the project explored how the expectation of various stakeholders could be met through the use of systems and standards.

This work was important because it focused more on the management process itself and the elements of the various Standards and systems investigated. It meant that the diversity of issues that a management systems approach would have to deal with was considered in the light of the benefits that farmers could expect. This paper was one of 13 published in a special issue of the *Australian Journal of Experimental Agriculture*, drawn from the presentations at the 4th National EMS in Agriculture Conference, Beechworth, Victoria 17-20 October 2005. This special edition of the journal was itself a significant contribution to the study of EMS in agriculture, and reported on several of the EMS Pilots. Finally, this publication demonstrated that by applying a standardised approach to management of a farming business, benefits and outcomes across a diverse range of management areas could be achieved in a way that allowed 'proof' of such management to be expressed in outcomes and indicators relevant to various external stakeholders, as well as to the individual farmer.

**The following contents has been removed for
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Publication 4: Carruthers, G. (2007) 'Using the EMS process as an integrative farm management tool'. *Australian Journal of Experimental Agriculture*, 47(3), 312-324.

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Publication 5: The intrinsic features of Environmental Management Systems that facilitate its adoption and encourage innovation in primary industries

Carruthers, G and Vanclay, F. (in submission). The intrinsic features of Environmental Management Systems that facilitate adoption and encourage innovation in primary industries.

Submitted February 2011 to the *Journal of Environmental Management*

This publication is an examination of the aspects of adoption of innovation in agriculture. This paper was co-authored by my supervisor, Frank Vanclay (35%) and myself (65%).

The purpose of the paper was to assess whether EMS adoption is similar to the adoption of other, more technically or production focused innovations. The paper examines whether a specific focus on management practices and behaviours (created through an EMS) rather than on technical areas provides a point of difference in adoption. It explores whether the directed, analytical and focused issue identification, problem solving and assessment cycle inherent within the EMS process itself could influence adoption. The paper sought to identify barriers and incentives for adoption of EMS that might be common to the adoption of other innovations in order to anticipate solutions to these barriers and highlight incentives. In particular, we considered two characteristics previously found to influence adoption of improved natural resource management practices – ‘relative advantage’ and ‘trialability’ (Pannell et al. 2006).

The previous publications in this thesis established that using an EMS process is an effective management tool, successfully implemented in a range of farm contexts, and producing a range of measurable outcomes. The use of EMSs was not limited to corporate farmers, or to farms owned or managed by exceptionally well-educated and wealthy farmers. Rather, EMSs appeared to be used by farmers who recognised the opportunity offered by a new way of doing their job. In this way, the adoption of EMS can be thought of as similar to the adoption of other innovations and therefore,

similar factors could influence adoption. However, certain elements of an EMS can also be seen as promoting adoption, and therefore, it was useful to consider whether EMS adoption was indeed similar to adoption of other innovations, rather than just an innovation in itself.

In terms of relative advantage, a number of aspects of the EMS could be judged to provide relative advantage to the user, while the relative advantage of other features were strongly influenced by the starting point of the user. No clear negative comparisons were observed. In terms of triability, only one clearly negative feature of EMS was identified – that of lack of similarity to familiar practices. However, this aspect may not hold if farmers have been involved in other management systems, such as those addressing quality or occupational health and safety.

The paper contributes to the overall understanding of the use and adoption of EMS in agriculture by considering how the elements of an EMS itself can promote adoption, rather than examining the outcomes of adoption in isolation. The paper also highlights that the elements of an EMS can enhance uptake of a range of other innovations, and improve overall management capacity, by developing a focus on management capabilities in general, and providing feedback on management decisions and processes.

Title: The intrinsic features of Environmental Management Systems that facilitate adoption and encourage innovation in primary industries

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Abstract

This paper examines the theoretical underpinnings of the adoption of innovations, and applies this knowledge to the uptake of environmental management systems (EMS) amongst Australian farmers. We examine the specific features of the EMS process that might encourage or inhibit EMS adoption. We also consider elements of the EMS process to assess their utility in promoting adoption of various other innovations. We evaluate the EMS process in the light of two characteristics previously found to influence adoption of improved natural resource management practices – ‘relative advantage’ and ‘trialability’. Drawing on literature and our experience with farmers who have adopted an EMS, we conclude that the features of EMS promote the adoption of new practices as the elements of the EMS process actually create an on-going process of culture change as the EMS is implemented. We believe that the EMS process offers significant advantages to farmers seeking to improve production, whilst simultaneously meeting societal expectations for enhanced management of on-farm natural resources.

Keywords

diffusion of innovation, EMS, ISO 14001, sustainable agriculture, capacity building

1. Introduction

Australian agriculture has a long history of innovation, with Australian farmers recognised as leading adopters of new technologies (Guerin 1999). The need to deal with fluctuating climatic conditions, isolation, and the gradual development of a non European-centred agricultural ‘culture’, have encouraged innovation and inventiveness. Further adaptation of practices has occurred as a result of the increased focus internationally on improved environmental management, usually referred to ‘natural resource management’ (NRM) in the Australian context. It has been recognised that the factors influencing adoption change over time, and vary according to individual circumstances and context. Some landholders will adopt certain practices but not others (Pannell and Vanclay 2011). Non-adoption of certain practices may also be rational in some circumstances (Vanclay 2004a; Vanclay and Lawrence 1994).

There has been a considerable body of research examining the adoption of new technologies by farmers (see for example, Abadi Ghadim and Pannell 1999; Abadi Ghadim et al. 2005; Barr and Cary 2000; Cary et al. 2001; Diederer et al. 2003; Grolleau 2007; Guerin 1999; Klerkx et al. 2010; Lockie et al. 1995; Pannell et al. 2006; Pannell and Vanclay 2011; Vanclay 2004a; Vanclay and Lawrence 1994). In particular, Pannell et al. (2006) clearly articulated the pertinent factors which influence the adoption of land management practices, highlighting the importance of ‘relative advantage’ and trialability’.

In this adoption literature, attention has shifted to give greater consideration to the ‘person’ factor in the uptake of innovations and to social issues generally (Vanclay 2004b). There has been a shift away from a technologically-centred, top-down, ‘magic bullet’ approach to one that focuses on those who are best placed to make changes – that is, the land managers themselves. In addition, as a result of increased concern about NRM, the approach farmers take to management of all aspects of the farm business has come under scrutiny by government environmental agencies, community environmental groups (NGOs), and researchers.

A trend in a range of industry sectors in response to social concerns for greater accountability is the increased use of management systems. A management system is a set of inter-related processes which help a business manager to identify risks, and

identify the right information at the right time to assist in making the right decisions to deal with these risks (Sheldon and Yoxon 1999). An environmental management system (EMS) is a particular type of management system that focuses on the environmental risks and impacts of any business (Hillary 2000). The EMS concept has been codified in the international Standard, ISO 14001. The increased adoption of EMS by farmers is therefore of considerable interest to those seeking to improve the environmental performance of the agricultural sector.

While EMS use is still relatively uncommon amongst Australian farmers, interest in the process is growing. Significant government funding has been provided for a number of farm trials in Australia. However, these trials focused more on whether EMS could actually be used on-farm, and there has been little research into the features of EMS that might encourage adoption. This paper considers this question and concludes that EMS has tremendous capacity to stimulate the adoption of a variety of innovative practices. In addition, using the factors identified by Pannell et al. (2006), this paper considers the extent to which EMS itself will likely be adopted by farmers. We draw on the existing adoption literature, literature on the uptake of EMS in a range of industries, and our considerable experience with the development, implementation and research into the use of EMS on farms (REFERENCES REMOVED FOR BLIND REVIEWING). We show that, not only is the use of EMS an innovation in itself, but that EMS provides a pathway for adoption of a range of new technologies and practices for landholders.

2. Innovation and adoption

An innovation is “an idea, practice, or object which is perceived to be new by an individual or other unit of adoption” (Rogers 1995, p.12). Therefore, even though an idea or a technology may have been in use for some time, it is the novelty of the concept to the new user that is critical in defining something as innovative. Thus, to implement an EMS would be an innovation for many business managers even though the internationally recognised EMS standard, ISO 14001, was ratified over 15 years ago. For some farmers, applying the concept of ‘business manager’ to themselves would also be an innovation, as farmers frequently do not perceive themselves in this way (Vanclay 2004a). Innovation in agriculture has evolved from single issue,

technologically-focused approaches, through the use of a suite of related management issues or practices (for example, best management practices), to addressing the processes of management (including dealing with social factors such as staff management, peer relationships, and social norms). Innovation is influenced by the interactions of many factors and is therefore often unpredictable (Klerkx et al. 2010) in both the approach taken and outcomes achieved.

The act of adoption does not occur in a single step. Rogers (1962, 1995) suggested that adoption occurs in a series of stages defined as knowledge, persuasion, decision, implementation, and confirmation. In this model, the adopter first learns of the existence of an innovation, how it functions, and whether it might be applicable to their situation. They then form an opinion about the value of the innovation. Next, they choose to adopt some (or all) of the innovation, or to reject it. If they decide to adopt, the next stage is implementation. Finally, the decision to adopt is either reinforced and continued (through positive outcomes) or re-evaluated in the light of other, conflicting information. Pannell et al. (2006) discuss variations on this basic model. Each stage is affected by various factors and they do not follow a strictly linear path. The adopter's ability to receive information, their capacity to analyse and use it, and many other variables affect the process. Adoption behaviour also shows persistence over time meaning that being an early adopter in the past increases the probability of being an early adopter of other innovations in the future (Diederer et al. 2003).

Since Rogers first advanced his ideas about adoption and the diffusion of innovations in 1962, much research on the topic has been conducted. Pannell et al. (2006) comment that the Rogers model is simplistic; arguing that the tendency to adopt will vary with time, differ depending on the type of innovation, according to the potential adopter's location, participation in awareness and other programs, and as a result of their past experiences, amongst other factors. Adoption is most likely to occur when the innovations fit with the adopter's own circumstances, beliefs and practices (Vanclay 2004a), when information about the innovation is available (Diederer et al. 2003) and when the innovations have high relative advantage (Pannell et al. 2006).

3. Learning styles, farming styles and social factors affecting the adoption of innovations

The concept of learning styles is based on Kolb's (1984) work which drew on the development stages described by Piaget, Dewey and Lewin, and examined the dichotomies between 'doing/watching' and 'feeling/thinking' as the two main modes for gaining and transforming experience. Experiential learning describes the need for a learner to recognise the need for change, to take action to trial an approach, to evaluate the outcomes of application, and then transform those learnings into action. Kolb (1984) summarised this cycle as concrete experience (feeling), reflexive observation (watching), abstract conceptualisation (thinking) and active experimentation (doing). Kolb defined four types of learning styles: diverging, assimilating, converging and accommodating. Just as Rogers (1962, 1995) defined the characteristics of early or late adopters, Kolb attributed various characteristics to people who predominantly used one or other of the learning styles. The important point of this understanding is that people do not all learn in the same way. Promoting innovation by farmers requires understanding the different learning styles of farmers and how they relate to information in different ways.

Styles of farming is a concept similar to learning style, but more comprehensive in that it combines learning style with other factors about farming, including knowledge and experience, aspirations and objectives, structural context, personal background, and values and beliefs. Vanclay and his students (Vanclay et al. 1998, 2006; Mesiti and Vanclay 2006; Howden et al. 1998, 2000) explored the concept of farming styles as a potential mechanism to understand how different types of farmers related to the uptake of specific innovations in different ways. They concluded that the concept was of heuristic value, but was not necessarily an indication of the conscious understanding of each farmer. Emtage et al. (2006) reviewed a range of farmer 'typologies', relating their findings to adoption of changed practices amongst farmers. These typologies in many ways reflected the farming styles discussed in this section, and yielded similar insights into adoption behaviour.

Guerin (1999), Barr and Cary (2000), Cary et al. (2001), Vanclay (2004a), Vanclay and Lawrence (1994), Pannell et al. (2006) and Pannell and Vanclay (2011) have all presented a range of social factors that influence the uptake of innovations amongst farmers. Institutional factors (policies, regulations, and incentives) and individual

and social characteristics (age, gender, education, cognitive styles, skills and motivation) all play a role. Vanclay (2004a) and Pannell et al. (2006) noted that landholders are more likely to adopt an approach when they perceive that the innovation will meet the needs of their own circumstances, and confer a relative advantage. Diederer et al. (2003) found that adoption of innovations was positively related to labour resources, position in the market, and past adoption behaviour.

The ability to alter one's frame of reference to consider new practices is also an important factor (van den Ban 1957). Shrapnel and Davie (2001) examined personality and other psychological issues as an aspect of farmers' capacity to change. Openness to new experiences provides an opportunity to firstly hear about, and then consider new approaches. Positive environmental attitudes were found to be more influential in the absence of strong incentives or disincentives for using particular practices (Cary et al. 2001).

An important aspect of adoption relates to the family situation in which the farm business operates. Most farmers are not sole operators, but run the farm along with other family members, sometimes representing more than one generation (Vanclay 2003, 2004a). In some cases there are financial partners who might not participate in the running of the farm but nonetheless may still influence decision making. Adoption decisions therefore may not rest solely with a specific farmer, but with all members of the whole family farm business introducing a much greater suite of influences that can impact on collective decisions regarding adoption of innovations.

The length of time a farmer has operated in a particular area may be a factor that influences adoption. In part, this may be related to their stage in the farm management 'lifecycle'. A farmer just starting out and anticipating many years of management will have a different frame of reference for considering adoption than a farmer who is considering retirement. Peer pressure and a sense of belonging are related factors that influence adoption. Parish (1954, p.213) observed that newcomers to an area, or to farming, already felt like outsiders and thus were "better able to risk their neighbours' ridicule" if newly-adopted techniques failed. Carruthers (2003) noted the effects of peer pressure on EMS adoption with some farmers stating that their neighbours already thought they were a bit unusual anyway, so this did not impact on their decision to adopt EMS.

The nature of support and communication networks in which an adopter operates, and the role of opinion leaders within that network, are also important features determining whether an innovation will be adopted. Being near to an adopter and being able to examine the steps, impacts, and outcomes of that adoption can mean that an observer will also likely adopt, as they are able to extrapolate as to whether the innovation will suit their own circumstances. Ammenberg et al. (2000) observed a similar phenomenon amongst small business operators noting that membership in support networks encouraged EMS adoption. Klerkx et al. (2010) claimed that innovation resulted from such networking and interactive learning, and could bring about institutional changes in behaviours and practices.

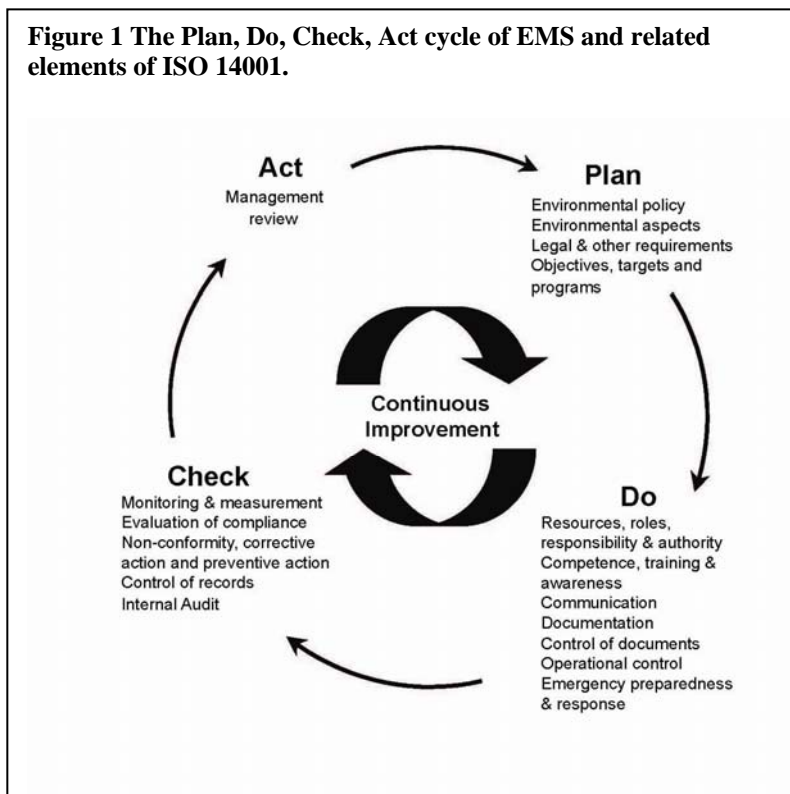
A major consideration in adoption is the financial capacity of farmers (Barr and Cary 2000). The level of equity has a positive effect on whether trials of a new practice would be conducted at all (Abadi Ghadim and Pannell 1999) and on the reflection on outcomes. Competitiveness within an industry sector is also an influence (Theyel 2000). The consideration of income and costs is confused by the fact that, in many cases, farmers who adopt innovations tend to have higher incomes (Pannell et al. 2006). Whether the higher income is the outcome or the cause of adoption is an unanswered question in much research, as studies are usually conducted after adoption has occurred. Lockie et al. (1995) and Vanclay (2004a) have noted that for many farmers, ever-increasing profit is not the main driving force for change, and therefore economic incentives alone are not enough to promote adoption. Farm size, staff numbers and the availability of labour, resources and skills have been reported to show a positive relationship with increased adoption (Parish 1954; van den Ban 1957; Abadi Ghadim and Pannell 1999; Abadi Ghadim et al. 2005).

The ability to observe and trial new practices has been demonstrated to influence the rate of adoption (Cary et al. 2001; Pannell et al. 2006). The complexity of practices has also been demonstrated to influence the rate of adoption (Cary et al. 2001; Vanclay 2004a; Pannell et al. 2006; Horne et al. 2008). If an innovation can be broken down into component parts, or fits well with existing practices, then it is more likely to be adopted than an innovation that requires a large shift in thinking. The perceived risks and uncertainty about outcomes are additional factors.

The above factors all play major roles in the decision-making processes engaged in by farmers contemplating any practice change relating to production or NRM. Therefore, it is to be expected that they will also affect decisions regarding the use of new business management practices, such as the adoption of more systematic processes such as an Environmental Management System. We concur with Pannell et al. (2006) that above all, 'relative advantage' and 'trialability' are perhaps the two most important of the factors that determine the potential of an innovation to be adopted. Later in this paper we consider the extent to which an EMS may be characterised as having these attributes.

4. Introduction to Environmental Management Systems

An EMS is based on the principles espoused in Total Quality Management (TQM) and on the concept of continuous improvement. An international Standard, ISO 14001, provides the basis for EMS development and certification. The management cycle is typically represented as four steps: 'Plan' (decide what you want to achieve), 'Do' (implement these changes), 'Check' (monitor performance) and 'Act' (reflect, review and refine the system where needed). The ISO 14001 Standard provides specifications for the elements within each of these phases (see Fig 1).



The 'Plan' phase of EMS includes identification of the legal and other required performance parameters, identification of environmental impacts and their causes, and development of the overarching goals and direction for the business (expressed in a policy statement) to address these issues. The 'Do' phase covers allocation of responsibilities, training, documentation, operational control and contingency planning. The 'Check' phase involves monitoring and measurement of performance (including the use of records), addressing non-conformance and auditing. Finally, following a management review, the 'Act' phase is where a considered and conscious choice based on information generated by the system is made regarding further actions, including modification of the system, in order to better achieve the outcomes set in the 'Plan' phase.

There are reported limitations in the ability of EMS to produce environmental and policy outcomes (e.g. Gunningham 2002, 2007). While EMSs seek to go beyond compliance, offering a more flexible approach to environmental management, their use must be underpinned by appropriate and well-enforced environmental regulations to ensure satisfactory performance. A blend of voluntary actions, legal, economic, market-based, and reputational incentives was suggested by Gunningham (2007) in order to encourage the full potential of EMS adoption. Vanclay (2004b) suggested that EMSs did not fully assess social considerations; however Carruthers and Vanclay (2007) established that EMS could in principle address social issues. Ridley et al. (2003) and Seymour et al. (2007) noted that the complexity of ISO 14001 could be a limiting factor in EMS adoption. They suggested using group learning and staged development and adoption approaches to address these issues.

ISO 14001 provides a strategically-focused framework that recognises that there are a range of significant stakeholder views (i.e. not only regulatory agencies) that need to be taken into account (Zutshi and Sohal 2003). ISO 14001 is a process-based approach, not a performance standard. This means that the motivations for EMS development will shape the system and its outcomes, and unless these motivations coincide with publicly-accepted environmental outcomes then EMS is likely to be perceived as failing to deliver benefits to society. Aligning EMS targets and outcomes with catchment (watershed) management and other publicly-set targets is one way to avoid this problem (Carruthers 2007; Seymour 2007).

Through the use of appropriate incentives and regulations, and when supported by government policy, the community, and farmer application, Australian agriculture could be encouraged to achieve sustainable practices in a more strategic manner. The use of the EMS process can provide an integrative tool (Carruthers 2007) that allows for simultaneous adoption of a range of innovations, while at the same time reducing risk, uncertainty and stress (Carruthers 2007).

5. Factors that influence the adoption of an EMS

The decision to seek EMS certification is multi-dimensional, drawing on technical, production, and financial factors such as customer and peer pressure, stakeholder interests, a desire to improve performance and to implement integrated management systems (Grolleau 2007; Marinova and Altham 2000). These factors have been found to vary across businesses, and given that EMS use is a continuous process, across years (Nishitani 2009).

Many of the factors influencing adoption of EMS are similar to those reported for adoption of innovations in agriculture in general. However, EMS adoption is different to the adoption of technological innovations in important ways. For example, an EMS is not a single, point-in-time solution. The use of EMS requires multiple decisions in an iterative pattern; and outcomes are neither fixed nor easy to measure. Further, there is no end-point for an EMS, as it is built around the concept of continuous improvement, and the expectation is that the process will continue to evolve. The list of factors that are reported in the EMS literature as influencing adoption of EMS are discussed below.

- Larger businesses are possibly more likely to adopt EMS (Noci and Verganti 1999; Nishitani 2009, cf Wu et al. 2007), and to seek EMS certification (Christmann and Taylor 2001, Chan and Li 2001) although this did not hold for Australian farms (Carruthers 2003, 2005).
- More profitable businesses are more likely to adopt EMS (Nakamura et al. 2001; Wu et al. 2007; Nishitani 2009); but Chapple et al. (2001) suggested less profitable firms might adopt in order to increase their competitive advantage.
- The provision of subsidies or incentives to assist with EMS development and implementation, to assist with the cost of certification (Toffel 2000; Wu et al.

2007), or to help with environmental training (Ammenberg et al. 2000), has been shown to be influential in EMS adoption.

- Firms established for longer are more likely to be able to deal with the risk of potential failure than younger firms, and are therefore more likely to adopt EMS (Wu et al. 2007). However, this might also work in reverse, as EMS adoption could lower the risk profile of a business, and therefore be more attractive to newer businesses.
- Participation in export markets, or having an export orientation particularly to countries with more stringent environmental regulation, has been shown as a factor in adoption (Carruthers 2005; Wu et al. 2007; Nishitani 2009).
- Participation in research and development activities that lead to the identification of potential innovations to assist in meeting specified outcomes is a reported influence (Wu et al. 2007).
- Location within an industrial park and/or participation in mentoring groups provides support and has been reported to be a positive influence on adoption (Ammenberg et al. 2000; Wu et al. 2007).
- Prior familiarity with a systems approach can encourage uptake (Corbett and Kirsch 2001; Maimon 2000; Casadesús et al. 2008; cf Grolleau 2007).
- The industry sector and the perceptions and actualities within its markets regarding pollution prevention can influence uptake (Wu et al. 2007; Nishitani 2009).
- Product traceability and proximity to final end-users in the market chain (Nishitani 2009) means that expectations regarding environmental performance may be more readily conveyed to producers, influencing EMS adoption.
- The timing of related changes can also be a factor. For example, more firms adopted EMS in Taiwan after EU regulations changed in favour of demonstrated environmental management and performance (Wu et al. 2007). Therefore, adoption may relate to the current regulatory situation both domestically and at export destinations. Similarly, action may follow the publicising of transgressions and/or prosecutions of businesses in breach of regulations.

- Competition within the industry sector (Theyel 2000) and the need for enhancement of image or reputation (Fronzel et al. 2008) may also apply (Nishitani 2009).

The regulatory regime in which a business operates may also be influential. Wu et al. (2007) reported that it is likely that government plays a role in determining environmental performance, but not necessarily in the adoption of EMS per se, as ISO 14001 is a process, rather than a performance-based approach. In regulation, outcomes are more likely to be specified than the means to achieve them (e.g. EMS). While government regulation drives the adoption of cleaner production technologies, the pressure for cleaner and greener consumer products arises predominantly from public environmental concerns (Kemp and Soete 1992). Therefore, it is fair to say that the public sets the overall greening agenda, while the government is left to work out how that might be achieved and regulated. Marinova and Altham (2000) suggested that companies with an EMS were more proactive and pre-empted government regulations and industry requirements. This comment was also made by a farmer who was an early adopter of EMS who said that his EMS placed him ahead, not only of his neighbours, but also of agencies in terms of performance and environmental knowledge (Carruthers 2003). Fronzel et al. (2008), on the other hand, stated that neither external pressure groups, nor any single policy instrument, influenced EMS adoption.

6. The use of EMS in agriculture

There are good reasons to encourage the adoption of EMS amongst small as well as large agricultural enterprises. Many smaller businesses are not subject to the same scrutiny as larger operations, and therefore their aggregated cumulative impact on the environment can be greater than larger operations (Ammenberg et al. 2000; Gunningham 2002). The use of EMS has been demonstrated to enhance environmental stewardship, enabling landholders to extend their management capacity (Higgins et al. 2008). Many of the factors mitigating against adoption of any innovation can be alleviated through the use of a systems approach. In small businesses with limited resources, such as farming enterprises, maintaining

flexibility, providing clear decision points based on accurate and timely information, and tailoring the management practices to the requirements of the individual business, is crucial.

Looking at the data published by the International Organisation for Standardisation, the level of adoption of ISO 14001 in most Australian industries is relatively high (on a per capita basis). Past EMS pilot programs in Australian agriculture, which were supported by the Federal Government, have seen adoption of at least some parts of the EMS process by over 1000 farmers in Australia. Accurate statistics on the number of EMS users are difficult to obtain however, as not all EMS users undergo certification, and of those who do, not all necessarily register their certification status. It is also difficult to obtain statistics on the numbers of users within any individual industry sector. The website of the Joint Accreditation Scheme for Australia and New Zealand (JASANZ) listed 1600 EMS registrations (to ISO 140001 standard) across all industry groups in February 2011, with only nine listed for agriculture. From our research we know that there are many more EMS users in Australian agriculture, some of which have undertaken external third party audits and received certification even though they do not appear on the register.

In thinking about the adoption of innovations, and of EMS in particular, there are two important matters to consider. First, the adoption of EMS is an innovation in itself. Secondly, as EMS is a multi-dimensional process, the uptake of each of the various elements of EMS also represents an innovation. For example, for a farmer who has traditionally done little strategic planning, the risk assessment and target-setting components of EMS represent innovative practice. Further, the implementation of an EMS can lead to adoption of other innovations that are not part of the EMS (see Marinova and Altham 2000; Florida and Davison 2001; Andrews et al. 2001). For example, a higher proportion of the EMS farmers reported using environmental best management practices or codes of practice than non-EMS farmers (Carruthers 2005).

7. Features of the EMS process that enhance adoption

7.1. Risk and context specificity

Abadi Ghadim and Pannell (1999) reported several studies that identified farmers as being risk averse. If the risks and uncertainties surrounding a new technology are perceived to be too high, then the likelihood of adoption is low. The use of EMS can be perceived as being risky due to the novelty of the process. However, an underlying feature of EMS is a risk assessment. EMSs are developed individually to suit each business, based on an analysis of the current context, practices, performance and processes employed (Carruthers and Tinning. 2003). EMS users identify potential environmental impacts, and prioritise these in order to address immediately those that pose the most significant risks, with lesser risks addressed over a longer timeframe. EMSs serve to reduce the risk of management overall, and provide information that should reduce risks associated with adoption. Shrapnel and Davie (2001) noted that the ability to respond strategically to stress was a major component in the survival of farming enterprises. Therefore, the establishment of processes like EMS that reduce risks through planning and evaluation, and the establishment of mechanisms to deal with problems if and when they arise, is highly beneficial. The risk assessment process inherent in EMS means that adoption of any innovation will also be assessed in the context of the individual user.

7.2. Flexibility

A virtue of EMS is its adaptability to each specific organizational context. Such flexibility is crucial because no two farmers, farms, or family farm businesses are the same (Vanclay 2004a). While much effort in agricultural industries has gone into the development of a variety of best management practices, many are seen by farmers as being restrictive and not suited to their particular circumstances. Prescribing specific practices and outcomes discourages innovation, removes the potential for experiential learning, and can reduce the ‘ownership’ of both problems and solutions. A farmer who was an early adopter of EMS commented that the code of practice developed for farmers in his industry was too prescriptive (Carruthers 2005). He felt that it gave the grower little control and made him feel that he was being ‘dictated to’. Using a management process approach (like EMS), rather than a prescriptive set of recommended practices, maximises the potential for farmer ownership of the

solutions developed and innovativeness in the approach taken, leading to wider adoption. A final noteworthy feature regarding the flexibility of the ISO 14001 process is that there are multiple entry points. For example, while for some users the main motivation for implementing an EMS may be to address legal obligations for environmental management, it is equally valid to approach EMS from a self or staff training perspective, from a communication-improvement point of view, or from a financial outcome focus. An EMS designed primarily to pass a certification audit will differ from one that has been designed to maximise environmental or financial performance. It is up to the EMS user as to which focus should be taken. While this can be problematic for policymakers who might be seeking specific outcomes, from a user's perspective it means that the EMS can be tailored to gain maximum benefit for the business. We argue that this approach will lead to lasting outcomes and is the better strategy.

7.3. Consideration of environmental impacts

Users of an EMS must identify the environmental impacts their business creates, determine the root cause of these impacts, and devise and implement mechanisms to address both causes and effects. Marinova and Altham (2000) reported that EMS users knew more about the impacts of their businesses and more actively sought solutions than non-EMS users. Consideration of environmental impacts must include abnormal as well as normal operating conditions, with associated emergency management planning. Therefore, a wider consideration of issues is encouraged through the use of EMS allowing for a better and more personalised fit of solutions and management to the specific circumstances.

7.4. Improved access to information

Using an EMS promotes information-seeking and frequently enhances information-sharing (Florida and Davison 2001). The generation of information regarding systems and performance outcomes was reported by farmers as a key motivation for using EMS (Carruthers 2003, 2005). EMS users have been found to draw on a wider range of sources of information than non-EMS users. Marinova and Altham (2000) found that companies using an EMS utilised a wider range of information, were better informed about the range of impacts their businesses created, and engaged in a greater degree of technology transfer and collaboration with a range of research and development organisations, government agencies, universities and other companies.

Carruthers (2005) found that farmers using an EMS included a wider range of stakeholders in planning changes on their farm, and tended to consult with a broader range of partners than non-EMS farmers. The involvement of stakeholders is a major influence on successful EMS adoption (Zutshi and Sohal 2003), presumably because this provides information and support for implementation. The importance of networking as a key factor in adoption of innovation-based strategies was noted by Guerin (1999) and Noci and Verganti (1999). Generating information by which to decide between conflicting choices means that the user gains more control over their personal situation. As uncertainty and perceived risk can reduce the chance of adoption of an innovation, information generated by an EMS presents an increased opportunity for adoption.

7.5. Training and education

ISO 14001 requires that training about EMS and about the environmental impacts of practices be undertaken. Pedersen and Nielsen (2000) found that the type of training sought tended to change over time, from that on EMS specifically to more task-related, on-the-job training. The spillover effects observed amongst innovation adopters can also be seen with EMS. Location of a business close to other businesses with an EMS, or adoption by peers, may prompt collaborative learning, reinforcement of positive results and mentoring (Ammenberg et al. 2000; Carruthers 2005; Wu et al. 2007). Pedersen and Nielsen (2000) discussed the cooperation created between suppliers and manufacturers using EMS in the market chain, promoting solutions to common problems and joint environmental outcomes. Farms and other small businesses have an advantage in the diffusion of knowledge and the use of EMS. Their small size and fewer staff means that education, training and communication, and the feedback provided by the EMS, are more easily communicated than within larger businesses.

7.6. Feedback loops are built-in

Because the ISO 14001 process requires a periodic review of progress against policy and objectives and targets, as well as consideration of the performance of the actual system, an EMS incorporates feedback loops based on data that the system itself has generated. Cary et al. (2001) emphasised the importance of such iterative reflexivity for enhanced adoption noting that for sustainable management, long time lags can occur between taking initial action and performance outcomes becoming observable.

For particularly intractable problems such as soil salinity, the need for clear direction, identification of the issues being addressed and the methods used to deal with them, robust testing, monitoring, and data retention and analysis – all key features of EMS – will provide landholders with the information they need for reflection on the effectiveness of actions taken. Enhanced skill development is an outcome of such reflection leading to further learning.

7.7. Dynamic systems

Systems employed should alter over time to reflect and utilise the learnings that have been generated, and to suit the needs of the individual business using the EMS. This was noted by Pedersen and Nielsen (2000) amongst Danish companies, reflecting both the growing familiarity with, and confidence in using an EMS. EMS Manuals for each business became shorter with each iteration, and in some cases, written procedures and documents were transferred into wall charts, flow charts and similar documents. Farmers also reported this effect, with some noting a decline in the paperwork retained and required as their system developed (Carruthers 2005). Other areas of change as an EMS evolves include greater involvement throughout the market chain, introduction of life cycle assessment and green procurement practices, application of additional standards and specifications, greater use of certified or eco-labelled products, and the developing expectation that suppliers and contractors will also use an EMS. Outreach to market-chain partners, and to competitors in the same industry, to achieve better coordination and overall industry performance has been reported (Florida and Davison 2001). The focus of audits also changes over time. Once certification had been gained, compliance is often no longer the main focus of EMS audits – rather, audits are used to investigate whether the systems and activities put in place fulfil a company's requirements (Pedersen and Nielsen 2000).

7.8. Culture change becomes embedded

Agryis and Schon (1978) highlighted the need for culture change within a business as a prerequisite for permanent improvement in environmental performance. Coglianese and Nash (2001) discuss several cases where an EMS led to such culture change. Pedersen and Nielsen (2000) noted that over time the EMS transforms from being a special project into being part of accepted daily routine. The focus changes from development to maintenance, and to the creation of new opportunities and value for the business. Updating and maintaining the system, and building improvement into

it, is a sign of the system's maturation. López-Fernández and Serrano-Bedia (2007) demonstrated that development and implementation of EMS produced organisational and management changes in a range of areas for small businesses in Spain, suggesting that the intensity of change alters over time. This is evidence of actualisation of the key underpinning principle of EMS, continuous improvement. Theyel (2000) considered that continued improvement was more likely when management practices like EMS were adopted because, by their very nature, these practices become embedded within the firm's production systems. Keeping EMS moving forward, however, can be a challenge, particularly as the EMS matures and more intractable issues need to be addressed. As Pedersen and Nielsen (2000, p.35) discuss, "it is visible targets, actions and results that provide effective motivation, and it is a big challenge to keep having something on the agenda that will do this". The periodic review and audit structures built into an EMS ensure that such challenges are met, with information provided regularly on progress, and consideration given to the lack of progress when necessary. Balzarova and Castka (2008) demonstrated that making changes to an EMS was more difficult in the operational stage than the implementation stage. They argued that making changes to the EMS structure and function, and maintaining employee commitment, was easier in the initial phases. Keeping a balance between success, ease of use, and improvements in outcomes was a major key to on-going EMS evolution and acceptance.

8. Overcoming the barriers to adoption

EMSs have many features that serve to encourage uptake not only of EMS, but of other innovations as well. The flexible, systematic and iterative approach of EMS provides scope to contextualise management based on individual circumstances, address specific risks and business related issues, and therefore to enhance the adoption of innovations. However, it is evident that barriers to EMS adoption exist for both primary and other industries, and that these barriers are similar to those observed for the adoption of other innovations. Factors such as cost, perceived riskiness, concerns about the necessary skills, time and resourcing are all common between the adoption of EMS and other practices. Balzarova and Castka (2008) provided a comprehensive listing of the barriers to the maintenance of EMS

certification posed by each element of the ISO 14001 Standard, and Gunningham (2002) discussed barriers to EMS adoption specific to small to medium enterprises. These are similar to the barriers to initial adoption of EMS (Carruthers 2003, 2005) found amongst farmers. They are also consistent with the barriers to the adoption of cleaner technologies reported by Kemp and Soete (1992). Gunningham (2002) added that smaller businesses are not greatly 'exposed' to pressure groups (by virtue of their size), are only a small target for lobbying, and are subject to infrequent regulatory oversight, meaning that many gamble on 'not getting caught' for non-compliance. A common thread to these barriers is lack of knowledge or understanding either about the elements of ISO 14001 itself, or lack of information required to address the elements. In fact, as expressed by Gunningham (2002), the biggest obstacle to small businesses adopting ISO 14001 is that they have simply not heard of it.

Another key barrier to EMS adoption is that farmers typically do not see themselves as being business managers (see Carruthers and Vanclay 2007; Vanclay 2004a). Thus, the idea of using a management system can seem foreign, even though farmers do in fact utilise many elements of the EMS process. A further barrier is the lack of recognition by farmers that much of their everyday decision-making and planning actually does form part of a management system. The perceived costs of EMS development can also form a barrier to their adoption. As stated by Gunningham (2002), the costs of EMS are up-front, but the benefits are evident in the long-term. There has been little rigorous evaluation of the resources needed to develop and implement an EMS in the resource-poor context of a farm. It is difficult to assess costs and benefits of EMS adoption in agriculture because farmers often have little detailed information about the breakdown of their expenditure (e.g. differentiation of production and environmental management costs) and poor knowledge of unit cost of production. It is also difficult to assess the use and non-use values of the asset base (natural capital) specifically in terms of the NRM dimensions of their farm (e.g. biodiversity, water quality, and habitat protection). Carruthers (2005) found that farmers frequently did not identify the environmental management costs from general operating costs. Part of their motivation in implementing an EMS was to get a better understanding of their management and associated costs. Of the EMSs that have been established in Australian agriculture, many have been developed with

outside assistance, and in some cases, with incentive payments. There is little accurate information on the true cost of EMS development and implementation. The time and resources needed to develop the EMS can be reduced by different businesses (or farmers) working together as a group, sharing costs of development, resources, tools, auditing and certification. Group EMS development and certification has been used in a range of industry sectors (Ammenberg et al. 2000) including agriculture (Yiridoe and Marrett 2004).

Fear of paperwork is a common but unfounded barrier perceived by farmers. This has also been reported in other industry sectors. However, one of the managers interviewed by Pedersen and Nielsen (2000) stated emphatically: “We do not drown in paperwork – this is a myth!” Paperwork requirements evolve over the life of an EMS, and in many cases they are actually reduced, not increased, through using an EMS. Guided by the risk assessment process, EMS users are able to focus on more critical areas of management and find that they usually refine the areas that they are addressing, with a concurrent reduction in unnecessary paperwork.

Vanclay (2004a) emphasised that the more complex an issue is perceived to be, the more resistance there will be to adoption. While there is often a perception that an EMS must be complicated, the process approach outlined by ISO 14001 allows for small steps to be taken, gradually building into a whole management system. In this way, while the whole may be greater than the sum of the parts, the parts are still attainable and individually worthwhile. In order for this to occur, however, it may be necessary to make use of mentors or facilitators.

9. Relative Advantage and Trialability of EMS

The capacity-building elements of EMS – the iterative and flexible nature of the process and its adaptive management features – provide scope to overcome the barriers to adoption. In order to assess the capacity of the EMS process to overcome the barriers outlined above, its capacity-building features were compared to the specific attributes of the practices affecting adoption discussed by Pannell et al. (2006) (see Tables 1 and 2).

Table 1 Compatibility of EMS with the ‘relative advantage’ attributes described by Pannell et al. (2006).

Attributes of Practice¹	Compatibility of EMS elements²	Comments
Short-term input costs, yields and output prices	+/-	There will be a short-term, immediate cost for EMS implementation, with possible associated costs for actions. However, there is often a range of short and longer-term improvements in productivity and management efficiencies that off-set these costs.
Impact on medium-to-long-term profits	+	Many EMS users report improvement in resource use efficiency, management efficiencies and thus longer term profits. This is often matched by cost shifts to address management changes.
Impacts on other parts of the system	+/-	This factor is quite variable for EMS, as the starting point for environmental and business outcomes will invariably differ between users. It is not possible to predict in a generic way whether this would be a positive or negative attribute for EMS.
Adjustment costs	+/-	Again, this factor depends greatly on the starting point. Costs may be lower for farmers who already have a relatively sophisticated approach to management and NRM, but will be higher for those without this who need to ‘catch up’ to minimum performance levels.
Impacts on riskiness of production	+	Due to the risk-based nature, and capacity for contextualisation, of the EMS developed, risks should be recognised and planned for. Therefore overall risk to production, as well as other risks (such as liabilities for non-compliances) should be lower.
Compatibility with existing technologies	+/-	Variable, this depends greatly on what is already in place. Often adoption of systems thinking can be a major step forward for farmers, but others may already utilise the approach.
Complexity	+/- (p)	EMS is often perceived as complex, yet is really a series of steps that build on and support each other. Leaving out any of the elements actually serves to weaken the systems overall. Experienced EMS users often comment that the risk assessment and information filtering provided by an EMS can actually reduce complexity associated with decision making and management.
Government policies	+	In Australia, at least, there were strong initial moves by governments to support EMS adoption (although this support was subsequently largely withdrawn).

Costs of practices to be replaced	+/-	Variable, depending on existing practices. Can also be difficult to quantify for costs of business management as opposed to on-ground works and infrastructure costs.
Compatibility with existing beliefs and values	+/-	As EMS can be used by anyone, it is not possible to assess compatibility with existing beliefs. It is difficult to imagine however that someone who vehemently opposed 'green' management who start to use an EMS.
Impact on family lifestyle	+/-	Depending on the changes made, and the circumstances in which the EMS is implemented, there could be both positive and negative effects.
Self-image and brand loyalty	+	Generally, EMS allows greater confidence in management and provides an enhanced ability to demonstrate responsible management. These factors can be used to build awareness of the 'green attributes' of the products and services the farm provides. However, peer pressure has also been shown to be a factor in EMS adoption.
Perceived environmental credibility	+	Using an internationally recognised Standard provides credibility, and this can be further enhanced by utilising third-party auditing and certification.
High establishment costs	+/- (p)	Again, this is often a perceived, rather than a real barrier for EMS, and will depend greatly on the processes and practices already in place. Information costs can often be high for EMS development on farm.
Long time scales	+	EMS recognises a range of time scales for addressing issues on-ground, and caters for this through the strategic planning approach.
Riskiness	+	As above, risk is reduced through the use of EMS.
Complexity	+/-	While the whole is greater than the sum of the parts for EMS, it is possible to focus on differing aspects of the process, which serves to break down perceived complexity.
Spillovers	+	The communication and training aspects of the EMS process serve to increase potential for spillover, particularly as EMS encourages interaction with a wider range of stakeholders.

¹. These attributes are taken from Pannell et al. (2006)

²+ refers to a positive capacity for EMS to address the attribute; - refers to a negative capacity, (p) indicates perception.

In terms of relative advantage (Table 1), the EMS process reduces risks associated with production, reduces a range of costs (thereby improves profitability), is supported by government policies, enhances image and brand identification, and, if based on recognised standards, increases the credibility of practices. In addition, both short and long-term issues can be comprehensively addressed. It is more difficult to assess the influence of the EMS process when considering the factors of compatibility with other practices, adjustment costs, comparison with existing costs, impact on lifestyle and establishment costs, because EMS users will have a wide range of starting points. Therefore, they may have either a little or a great deal to do to enhance management in these areas. The flexibility of the process-based EMS approach means that these variations in current performance are not insurmountable, and landholders can develop EMSs and utilise other innovations suited to their particular circumstances.

As for suggested trialability factors (Table 2), only one clear negative comparison arises – that of the lack of similarity to familiar practices. This is the case because, as noted above, EMS is a novel concept for many farmers, and because many farmers do not recognise the management aspects of their own activities. However, this is a generality, and some farmers are already using other systematic processes (such as quality or occupational health and safety systems), thereby negating this effect in those cases. Observability of results, threats to trials, long term performance indicators and spillover effects are all positively impacted upon and addressed by specific elements within the EMS process. Divisibility, time lags, complexity and costs are all dependent to some extent on the starting point and the approach taken to EMS development, and will vary depending on circumstances.

Table 2 Compatibility of EMS with the ‘trialability attributes’ described by Pannell et al. (2006).

Attributes of Practice ¹	Compatibility of EMS elements ²	Comments
Divisibility of innovation	+/-	The EMS process can be further broken down into its various elements, with the emphasis altered as required by the particular user. However, if all elements are not employed, then the benefits of systematic management are lost. Trialling of an EMS is also possible, again allowing divisibility.
Observability of results	+	The monitoring and evaluation of outcomes derived from EMS implementation are crucial for successful use of EMS. Depending on the issues address however, some outcomes can be difficult to observe. Management systems are both data-driven and data-driving, increasing the chance of observability.
Time lag	+/-	Again, dependent on the issues addressed. EMS can deal with both short and long-term areas of management and NRM.
Complexity	+/-	An EMS can require change in a multiplicity of areas, and therefore can require a complex set of decisions. However, by specific planning and observation of results, the complexity of outcomes can be reduced, or at least become more manageable.
Cost	+/-	The cost of EMS implementation varies considerably, dependent on the starting and finishing point (e.g. certification, self-declaration, or non-certified use), the issues address and the degree of change needed. However, the user is in control of the decisions made, and so can adjust actions to suit the financial and other resources required to address issues.
Threats to trial	+	EMS required assessment of both normal and abnormal operating conditions, in addition to planning to deal with emergencies. Thus, threats are planned for, and should be less difficult to address should problems arise.
Indicative of long term performance	+	The monitoring and evaluation components of EMS provide information on which to base long-term trend analysis. Coupled with the required record keeping and documentation, more accurate and timely information is available on which to assess performance against targets.

Similarity to familiar practices	-	Many farmers (and indeed small business operators) often do not see themselves as managers, and have had little experience with the concept of management systems <i>per se</i> . Therefore, the concept can seem foreign. However, EMS users generally find that they are already using at least some components of the EMS process.
Spillover	+	The outcomes produced by an EMS in terms of NRM are positive, and visible in many cases. In many cases, not only are on-farm issues addressed, but catchment and industry targets also form part of the management regime in an EMS, creating a positive spillover benefit. Additionally, where market premiums or access have been gained, a further incentive occurs.

¹. These attributes are taken from Pannell et al. (2006)

² + refers to a positive capacity for EMS to address the attribute; - refers to a negative capacity, (p) indicates perception.

On balance, the EMS process appears to meet many of the requirements postulated by Pannell et al. (2006) to increase adoption. The features of EMS outlined above that enhance adoption, and the way in which these features also address the adoption factors discussed by Pannell et al. (2006) means that the EMS process is a valuable tool to encourage adoption of innovations by landholders. Further, the EMS process provides a robust mechanism by which to validate the use of a range of practices, allowing farmers to refine and further develop their management practices, seek and use a wider range of information, and enhance their capacity to deal with changing circumstances. The elements in ISO 14001 also meet the features of ‘absorptive capacity’ (the limit to the rate or amount of information that a business or person can absorb to aid in their learning and management) outlined by Cohen and Levinthal (1990). The capacity to exploit an innovation, the acquisition, assimilation, transformation and application of new knowledge are all specifically addressed by various elements of ISO 14001.

10. Conclusion

No one approach will lead to perfect NRM or farm management. In order to encourage farmers to adopt innovations that address NRM issues, management capacity overall must be increased. The EMS process offers great potential for the development of robust management systems that overcome many of the established

barriers to adoption of innovations. An EMS based on ISO 14001 offers a flexible process to capture the context in which the system is being applied, builds on adaptive learning processes, and ensures accurate information is collected, analysed and used for improved management decisions. As such, EMS offers a cost-effective and efficient way for farmers to address the requirements of their diverse stakeholders while at the same time addressing their primary concern, a sustainable business. Further, it is apparent that the use of an EMS is not only an innovation in itself, but that the use of an EMS encourages the uptake of other innovations. Governments and industry groups need to build on previous EMS experience, by increasing awareness of the process, providing information about EMS and its application, and supporting the availability of skilled and informed facilitators.

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Publication 6: Enhancing the social content of environmental management systems in Australian agriculture

Carruthers, G and Vanclay, F (2007) Enhancing the social content of environmental management systems in Australian agriculture. *International Journal of Agricultural Resources, Governance, and Ecology* 6(3): 326-340.

The paper was developed in part to refute claims that EMS process disregarded social issues (a concept in fact raised by the 2nd author of this paper in 2004). The ISO 14001 Standard was examined and specific clauses of the Standard that are designed to emphasise and enhance social factors in order to ensure successful EMS development and implementation. I felt it was important to explore this issue for two reasons. The first was that without consideration of social factors and a focus on creation of a cultural or 'mind shift' in EMS users, EMS implementation was difficult and could be expected not to be sustained in the long term. Secondly, while it was apparent from the case studies and other research I had completed that social factors were both important to and influenced by EMS use, many EMS users, certifiers and facilitators did not recognise them, or actively value these issues. This paper was an attempt to correct this oversight.

For this reason, this paper has been placed last in the series of papers. In many ways, the social changes and outcomes of EMS use have been the 'hidden' jewel in all of the changes I have observed as farmers have developed, implemented, and improved their EMSs. The cultural shift was often one of the most significant, yet least anticipated outcome created by EMS use. Typically, market benefits, regulatory relief, enhanced compliance and efficiency were the looked for drivers and expected benefits reported by many farmers. The social outcomes often came to attention later in the implementation process, but they were often the most highly regarded (and difficult to measure) outcomes.

In terms of significance of contribution, this was one of the first papers to consider specific elements of the ISO 14001 process in the context of their contribution to

social change. The paper also raised the very significant issue of how an EMS is assessed and valued, and the need to consider social issues as not only an important outcome, but also a vital component in supporting and encouraging on-going implementation of EMS. The paper also highlighted the need for auditors and others assessing EMS implementation to be open to the consideration of social outcomes arising from EMS use and to be able to effectively measure such outcomes.

I contributed somewhat more to the development of the paper than my co-author, Frank Vanclay, with a 65%:35% split of authorship.

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**Publication 6: Enhancing the social content of environmental
management systems in Australian agriculture**

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Recommendations and Conclusions

Genevieve Carruthers
(written for this thesis)

The purpose of this chapter is to:

- determine the relevance of the EMS process as described by ISO 14001 to agriculture
- provide answers to the primary research question and sub-questions
- reconsider the significance of the research
- make recommendations pertinent to enhancing the use of EMS in agriculture in the future

Recommendations and Conclusions

1.0 Introduction

This thesis has examined:

- whether EMS, as outlined in the ISO 14001 Standard, can be used on farms
- whether there any benefits from using EMS
- whether benefits are these measureable
- whether EMS assist with integrated management and, if so how, does the process add value to other management approaches, and
- whether there is any social change created as a result of EMS use.

To evaluate these questions, I have drawn on my own research into the use of, facilitation, development, and implementation of EMS on numerous farms (both in Australia and internationally), conversations with other EMS facilitators (from a range of industries), my participation and observation in the EMS Pilot, Pathways projects and interactions in a number of international projects aiming to use EMS in agriculture. Many of the outcomes reported in overseas studies mirror observations from Australian application of EMS on farms.

2.0 Responses to the research questions

In this section, drawing on the publications presented in this thesis and the results of participant observations in a range of EMS fora, concise responses to the primary and subordinate research questions, as presented in Section 4.1 of the introductory chapter, are provided. Numbering of the responses below reflects the questions detailed in the introductory chapter.

In order to address the multiple drivers for farmers to deal with improved management of natural resources on- and off-farm, any management process must provide benefits across the triple-bottom line areas of environment, financial and social issues. To achieve this in the agricultural sector, any management approach must provide the majority (if not all) of the following features:

- international recognition of the approach used, due to the export-oriented nature of much of Australia's agricultural production
- flexibility to deal with differences in enterprise, location, business structure and business size
- the ability to deal with the pressure to either 'get big or get out' (requiring production intensification and thus greater focus on business management) or pursue niche marketing and product differentiation (requiring a greater focus on traceability and verification of any marketing claims); or to do both
- consistency and repeatability of practices
- provide assurance that regulatory requirements (including catchment-focused requirements) are taken into consideration in management actions
- provide assurance that consumer requirements for safe and sustainable production processes are being managed
- allow for 'reportability' and verification of actions and outcomes achieved through credible monitoring, reporting, and certification
- potential for capacity building for business management overall
- the ability to enhance communication and partnership development
- cost-effectiveness and ease of use.

The EMS process, as described by the international Standard, ISO 14001, allows all of these requirements to be met, and in a way that can be customised to suit the individual EMS user.

2.1 The primary research question

The primary question of this thesis was **‘Does EMS use on farms produce benefits for the user, the public and the environment?’** From the research conducted, it is apparent that diverse industries are using the EMS process to gain numerous benefits, both within their own businesses/organisations and outside them. In Australian agriculture specifically, while the application contexts differed, the benefits (as well as drivers and barriers) mirror those reported in other industry sectors. In most cases, the benefits reported were linked to the drivers and motivations for initial EMS establishment, demonstrating that a planned approach will lead to desired outcomes. At present for agriculture, the personal and social benefits of EMS use are greater than financial benefits. Market benefits are achievable, but require concentrated marketing and promotion, along with consumer education, and at present, in Australia, these prerequisites are not in place.

Farmers often also reported ‘surprise’ benefits. These outcomes usually related to the social benefits of EMS, such as enhanced communication with stakeholders, increased agency support and dialogue, improved staff and community relationships and enhanced confidence in management. These surprise benefits appear to have a great influence on continued EMS use, but are often under-recognised and undervalued, sometimes even by the users themselves. Such surprise benefits tend to encourage and embed practice change, as the EMS outcomes are more personally relevant if they are internalised through such changes. However, in terms of encouraging widespread adoption, surprise benefits make it difficult to direct any EMS development towards generating such benefits in a strategic manner.

Benefits need to be considered in the context, and at a scale for which the EMS was designed and intended (Mech et al. 2003). For agriculture, this is obviously at the farm scale and in the business context. The following benefits of EMS adoption on

farms in key areas of financial, business management, environmental and social considerations were noted in this research:

- improved production levels
- increased ease of market access into some environmentally sensitive markets
- increased focus on business management
- improved motivation to increase business management
- enhanced ability to source information to assist with management
- increased ability to demonstrate stewardship practices
- enhanced knowledge of risks, including knowledge of compliance requirements
- better ability to report and monitor both original NRM conditions and progress towards goals
- improved natural resource conditions
- increased awareness of environmental issues both on and off-farm
- increased competitiveness in applying for funding to support NRM initiatives
- better information on which to base management decisions and future policy.

The benefits were offset in some cases by negative outcomes. For example, in addressing the use of chemicals, some farmers had to use different chemical management regimes, which did not provide the results as previous regimes. For others, savings on farm inputs were balanced by increased costs in other areas – for example, chemical use reductions meant that more intense pest monitoring was required. Cost shifts were encountered in some instances.

2.1.1 Financial benefits

The achievement of financial rewards as a result of EMS use has typically been the major attribute assessed as a benefit and also measure of the success of EMS. Reductions in input costs, increased production levels and enhanced marketability and/or market access were all financial benefits reported by EMS users (Publications 1 and 2). Closer attention to the timing, application methods, and need for inputs allowed costs to be reduced (discussed by case study participants in Publication 1), increasing productivity. Increased efficiency in management (reported by many of the farmers) also resulted in reductions in the amount of time required to address problems arising, also providing costs savings overall.

In contrast to observations by some researchers (e.g. Tee and Boland 2005; Pahl et al. 2007; Seymour et al. 2007), price premiums were reported by participants in the EMS Case studies, EMS Pilots, the EMS training video participants, and by farmers surveyed for this thesis. However, the instances of premiums were few, and were achieved only with concentrated and prolonged marketing to promote the particular products (for example, the Ecobananas described in Publication 1). EMS marketing assisted in providing an overall product story, and did not simply promote the use of a management system adding to the product story – in other words, the EMS itself was not the marketable product.

Price premiums were achieved by EMS users who had applied the full EMS process, and in the case of Rocky Point Prawn Farm and Pacific Coast Ecobananas had undertaken certification auditing, or assessment for compliance against the Standard without certification, as was the case with the Gippsland Natural beef and lamb group. Consumers also need to be able to recognise the approach being used; creating the need for external validation and, in some cases, certification to provide credibility around the sustainability story being told, partially through EMS. Certification and third party assessment strengthened the credibility of claims regarding application of the Standard.

There was evidence of market access and entry to previously restricted markets due to EMS use, e.g. the Abbotsleigh Citrus farm (Publications 1 and 2). Market maintenance due to having a certified EMS in place was shown by the persistence of the Rocky Point Prawn Farms produce in Japan markets (Publication 1).

Many factors are needed to achieve such market outcomes for EMS, however, at present many of these are not yet in place in Australia or elsewhere (see Bird and Bushman 2005). For example, there is virtually no consumer education about EMS, what it can and cannot deliver, few mechanisms exist for product differentiation and traceability (as ISO 14001 does not provide an eco-label in itself) and conflict and confusion exist about organic produce, ‘sustainable’ and products grown using EMS approaches. In addition, in Australia there is not yet the critical mass of farmers using the EMS process to enable or support EMS-related marketing campaigns at a large scale. This is similar to the early days of recognition of organic production, where problems of supply maintenance often reduced consumer ability to

preferentially purchased certified and labelled organic produce, a problem that has continued (Department of Agriculture, Forestry and Fisheries 2004).

Finally some farmers (Publication 1 and 4) reported ease of gaining funding to support on-ground initiatives, due to better alignment of their farm plans against catchment management targets and an improved ability to prove environmental outcomes created by enhanced record keeping and data management as other financial benefits.

2.1.2 Business and management benefits

EMS users improved business management skills by giving greater consideration to compliance issues, meeting legal obligations, undertaking risk assessments and using a more aggressive and strategic approach to business management. An increased focus on assessing the outcomes of business management was created by the EMS process, leading to more targeted monitoring and use of indicators (Publication 3). The dairy EMS research (Publication 4) highlighted how the EMS process increased the operator's focus on their entire business operation; streamlining management while simultaneously meeting external requirements placed on the business. Increased awareness of legal obligations reduced the risk not operating in compliance with regulatory obligations, reducing business risk and liabilities. In turn this improved the relationship with financial institutions and agencies, particularly as reporting of environmental management commitments and outcomes achieved through the EMS could be more easily reported and validated with improved monitoring data. Bird and Busman (2005) noted similar outcomes in their US study.

Improving information flows through the business, proactively monitoring outcomes, preparing contingency plans, and critically reflecting on outcomes meant that progress in a range of areas was more effectively monitored, and results of management could be readily communicated to interested parties, including regulators and funding bodies. An increased focus was also placed on the act of management itself, meaning that a far more directed set of actions began to develop (amongst not only farmers, but also researchers, support agency staff and policy makers). Use of a more strategic approach, creating a comprehensive and cohesive management approach was also reported as a key benefit of EMS adoption in overseas EMS examples (Corbett and Kirsch 2000; Bird and Bushman 2005).

2.1.3 Environmental benefits

A very diverse range of environmental benefits were reported by case study participants (Publications 1 and 2) and grain and dairy farmers (Publications 3 and 4) studied for this research, covering both on and off-farm issues. An increased focus on environmental outcomes of management practices occurred for many farmers using EMS, as the management process promoted a more critical examination and reflection on the expectations, actions, and monitoring undertaken on farms. The case studies and EMS projects reported in this thesis noted more environmental monitoring and review, with target-setting to address issues a common outcome amongst EMS farmers (Publications 1, 2, 3 and 4). EMS users were more likely to manage, measure and report a greater range of environmental performance outcomes than non-EMS users including, in addition to the common soil, chemical water and biodiversity management issues, regulatory compliance, waste and energy use rates, and customer satisfaction measures (a trend also noted by Florida and Davison 2001). Bird and Bushman (2005) also reported that EMS farmers believed that negative environmental impacts would be significantly reduced as a result of EMS use, indicated that an expectation of environmental performance was created regarding EMS use.

2.1.4 Social benefits

This thesis clearly demonstrates (Publication 6) the social outcomes that can arise from EMS implementation – an area that has previously received little regard from those researching EMS application in agriculture. The use of the EMS process was found to open farmers, agency staff and researchers to increased communication and changed behaviours (Publications 1, 2, 4, 5 and 6). Many of the EMS Pilots and Pathways findings also noted that farmers engaged in additional discussions with extension and agency staff as part of the EMS process. The EMS process also provided a mechanism for change (Publication 5) often lacking in agricultural BMPs, which are more prescriptive (incorrectly assuming ‘perfect knowledge’ of all circumstances in which they are to be applied) and not as flexible in being adapted to individual business situations or localities. By requiring review and reflection, the EMS both creates anticipation of, and sets the stage for, change (Publications 3 and 5). For many years now, the policy agenda in Australian NRM has tried to support

the building of capacity and resilience amongst farmers. The use of EMS certainly prompted many farmers to have increased confidence in their management, develop a wider range of communication, consultation, and information sources (Publication 6). Thus, the EMS process clearly supports stated Government policy to enhance the capacity of farmers to deal with ever more complex NRM challenges. This is similar to the situation reported in the non-agricultural sectors, where the use of EMS delivers tangible and intangible benefits to the user, the community and assists in achieving public policy objectives (Coglianese and Nash 2001; Florida and Davison 2001).

2.2 Secondary questions

2.2.1 Sub-question 1: Is EMS relevant to the agricultural context?

The research discussed in this thesis shows that EMS can be applied effectively in the agricultural context (Publication 1 and 2). The EMS process adds considerable value to the existing suite of best management practices, policies, and industry initiatives for enhanced NRM by providing mechanisms by which these guidelines and practices can be fully implemented and assessed using the EMS process.

2.2.2 Sub-question 2: Are the benefits of EMS measurable?

This thesis demonstrates that the EMS elements provided diverse benefits and enhanced an integrated management approach (Publication 4). As reported in other industry sectors, EMS benefits are in some cases easily measurable, using existing indicators (Publication 3), but others were intangible, and of particular importance only to the user (Publication 6). The EMS process added value to indicator selection, and fed data back to the selection and consideration of indicators used in the EMS. Financial, business, production and environmental outcomes could be measured. Using a process approach facilitated integration of various management processes and reporting required to meet diverse stakeholders demands. However, the social outcomes of EMS implementation (Publication 6) were more intangible, and monitoring, measuring and reporting these outcomes was more difficult. Additionally, the timeframes necessary to allow EMS benefits to emerge were often not met in much of the EMS in agriculture research in Australia and overseas, with

projects often running for less than 3 years. Benchmarking and reporting of performance before commencing EMS development was rarely observed. Commonly, at least part of the EMS resources were dedicated to assessing production and environmental performance and outcomes, but social outcomes were more rarely assessed in many of the EMS projects.

2.2.3 Sub-question 3: Did EMS benefits match, reflect, or exceed those gained through the use of other natural resource management programs (such as BMPs)?

BMPs provide guidance to achieve specific outcomes. Benefits therefore were predictable, and reflected generally accepted industry standards. Most BMPs, however, do not include an expectation that outcomes may be modified to ‘go beyond compliance’, or that practices may need to be changed according to circumstances. An EMS, on the other hand, should deliver the outcomes that it is developed to produce, based on an analysis of risks specific to each user’s situation. Therefore, outcomes will vary considerably due to flexibility in identifying and prioritising issues to address and the range of solutions to deal with them. EMSs facilitated integration with other approaches (Publication 3); allowed innovation and adaptation of approaches (Publication 5); and accommodated the pluriactivity of farms in ways that enterprise-specific BMPs could not. The BMP approach often frustrated leading farmers, who claimed that the BMPs were often the lowest performance parameters that would be tolerated by the bulk of the industry (Publication 1). Many farmers also recognised that simply being given a checklist of actions to complete without critically thinking through the proposed actions and their implications for each business’s specific circumstances meant that opportunities to go beyond minimal conformance were lost, and innovation stifled. Unlike BMPs, the EMS process served to increase ownership of issues and solutions (also noted by Bird and Bushman 2005 in the US).

In retrospect, this sub-question would have been better phrased as “*Does EMS add anything to the use of existing BMPs?*”. While specific outcomes may be more predictably delivered as a result of BMPs, from this research it is concluded that the EMS process did add value to existing NRM and production BMPs through developing strategic and integrated management, provision of environmental benefits

to the community, and potential delivery of data on which to base future policy to agencies (Publication 4). The EMS process also built capacity to adapt management practices, operationalise existing BMPs, adopt innovations and promoted both communication and learning amongst farmers (Publications 5 and 6). Reith and Guidry (2003) described the benefits of an EMS as transferring a piecemeal BMP approach into an integrated approach for systematic improvement. They believed EMSs allowed a shift from issue-specific management to much more systematic, ecological-based management. The findings of Publication 4 support this conclusion. Many farmers also used EMS to address off-farm impacts, an area not covered by many BMPs. Finally, although claims of environmental friendliness were made for many BMP programs, the lack of validated independent review undermined any claims made. By adding the verification and review elements of EMS, the BMPs were strengthened overall, and reportability enhanced.

2.2.4 Sub-question 4a: Are EMS benefits limited to environmental matters and the individual only, or can use of EMS create public policy outcomes as well?

As shown in Publications 1, 2, 4, 5 and 6, the benefits of EMS application on farm extended beyond solely environmental outcomes and beyond the farm borders. Financial, business management and social benefits were observed in addition to environmental outcomes. In parallel to the findings of Publication 4, Bush and Birdman (2005) also reported that EMSs provided a framework which allowed producers to proactively meet requirements of catchment planning authorities and agency staff. Gunningham (2007) also recognised that the use of an audited EMS allowed users to demonstrate an environmental ‘duty of care’. The flexible, non-prescriptive approach of EMS contributed to public policy outcomes, by providing a mechanism by which community and governments can recognise those who are taking steps to address environmental issues that affect the wider community, without requiring a specific level of knowledge of either particular environmental issues or the means used to address them. Florida and Davison (2001) similarly reported a range of social benefits not only for the EMS users, but also for the community. EMS users were more likely to involve neighbours and other stakeholders in environmental priority setting and share information with neighbours and environmental groups. These authors also observed that there were spill-over benefits, in that community members themselves also started to address

environmental issues and reported increased environmental awareness. EMSs also have the capacity to generate data which can contribute greatly to information and data sources on which to base future policy, particularly relating to catchment management and related target setting. However, some work is needed on consistency of data collection and reporting, for this to be most effective. In addition, mechanisms to capture and use such data are currently not widely established and used, and require further development.

2.2.5 Sub-question 4b: Does EMS offer anything more as a policy tool to encourage changed practices?

From the evidence presented throughout this thesis, it is obvious that EMS potentially has a considerable role in assisting in the achievement of NRM policy outcomes in Australia. The EMS process raised farmers' awareness of environmental and compliance issues, and encouraged the identification of and involvement of a range of sources of support (Publications 5 and 6), including policy agencies. The EMS process created a need amongst users for enhanced information, encouraged learning and communication, and reinforced reflection on outcomes achieved (Publication 5). Such "active involvement and cooperation of citizens" was seen to be a key component of achieving policy outcomes by the Australian Public Service Commission (APSC 2007, p.31). The EMS process provided a useful mechanism to create engagement of diverse parties, as discussed in Publication 4. The social change capacity created through EMS (Publication 6) is an important component of increased engagement in achieving policy outcomes in the NRM arena. The focus of the Standard on communication, training, reflection, and review also means that social change can be created and enhanced in any enterprise. Given the complexity of the issue surrounding NRM, including the overlying factors of individual choices and circumstances that influence the decision to adopt an EMS, a blend of flexible and changing encouraging factors or incentives is likely to be required. The EMS process also met many of the conditions the Australian Public Service Commission (2007) saw as necessary for agencies to address 'wicked problems' in NRM, in that it was flexible, could be used between regions and localities, and could assist in promoting and embedding behaviour change in land users. Many of these recommendations apply equally as well to individual businesses, including farmer

enterprises. The mechanisms included using holistic thinking, innovative and flexible approaches, working across boundaries, inclusion of accountability, stakeholder engagement, core skill building and taking a long term focus.

EMSs also promote thinking about complex systems holistically – a factor seen by Ryan et al. (2010, p.14) to be essential in dealing with NRM on a landscape and individual scale. The use of EMS by land managers could also assist in meeting three specific recommendations (1, 4, and 9) of the Senate Enquiry into Natural Resource Management and Conservation Challenges (SSCRRATRC 2010). These recommendations respectively called for greater engagement of regional and local expertise in the identification of priority issues for land management (p.69), encouraged stakeholder collaboration “on long-term landscape scale strategic planning and action” (p.71) and suggested the development of “a framework and generic criteria which would form the basis for an ongoing process of audit of the condition of Australia’s natural resources” (p.73). The EMS process can inform these three recommendations by providing monitoring data, validation of recommended practices and feedback on the effectiveness of proposed strategies.

Overseas studies have also recognised the contribution EMS use can make to public policy outcomes. Vastag and Melynk (2002) claimed that ISO 14001 had a greater effect and was more efficient in improving performance when compared with other voluntary programmes used in the US. Coglianese and Nash (2001) investigated EMS as a means to achieve public policy goals, concluding that EMS could indeed play a useful role in achieve public policy outcomes for a variety of situations. Bird and Bushman (2005) concluded that EMSs can add considerable value to existing regulations, conservation programs, and risk assessment procedures. Importantly, the use of a standards-based approach meant that through auditing and certification, EMS practitioners could be recognised as achieving as specific performance outcome – that of the implementation of a management systems designed to address particular policy areas for NRM outcomes.

2.2.6 Sub-question 5: Could the EMS process integrate with other requirements farmers needed to address, such as quality assurance?

The EMS process allowed integration of a number of management processes to achieve greater performance gains and was easily developed into a whole farm

planning approach that addressed customer, community, and regulatory concerns (Publication 4). EMS undoubtedly related to other management issues for farmers such as risk assessment and record keeping, particularly these arose from other the systems-based requirements such as quality assurance. Previous experience with other management systems (such as quality assurance) can mean that many of the processes for EMS are already in place, even if they have a different focus (Corbett and Kirsch 2000). Having had to previously formalise systems for one approach can save both time and money for other systems development.

Integrated management directed through an EMS may bring about greater environmental change (Matias and Coelho 2002) when coupled with industry-specific best management practices (where these exist), codes of practice and similar, where performance outcomes are detailed (Mech et al. 2003) or through a blend of incentives, regulation, voluntarism and partnership arrangements (Gunningham and Sinclair 1999; Gunningham 2002; 2007). However, in practice, it is not always possible to integrate EMS with BMPs, as BMPs do not exist for all sectors, and when they do exist, often cover a limited range of issues, or are very site-specific. Easy integration is currently unlikely to happen unless there is significant injection of industry funds to develop wide-ranging BMPs which embrace a more systematic management approach. However, assistance is likely to be needed for farmers to achieve this, given that they often struggle to implement a single management system

2.2.7 Sub-question 6a: Does the EMS process enhance the management practices amongst farmers and increase their capacity to meet the challenges facing them? Sub-questions 6b: Did this also extend to other areas of their business management?

Farmers in the case studies, the grain farmers (Publications 3) and dairy farmers (Publication 4) along with other farmers who attended a range of EMS meetings commented on the culture change and thinking shift that occurred as a consequence of EMS use. For example, Wesley Hazzell (Publication 1 and 2) detailed how his thinking about the presence of insects in his orchards had shifted from regarding all insects as pests, to consideration of the various types of insects, and recognition of the beneficial nature of many of them. This came about due to the increased identification and monitoring of insects as part of the EMS. The EMS process

encourages and facilitates information exchange, builds capacity for improved decision making, and provides improved data on which to base decisions (Publications 1, 2 and 5). EMS use stimulated a longer-term, more holistic and strategic planning approach amongst farmers, and created more accurate data on which to base decisions. Farmers did not limit such approaches only to environmental management, but used these planning skills to cover all aspects of their businesses.

2.2.8 Sub-question 7a: Were there features of the EMS process itself that encouraged adoption?

A number of EMS Pilot and Pathways projects reported the value of the risk assessment processes, particularly its importance for raising awareness of environmental impacts (often off-farm) and of legal obligations. Farmers generally liked the risk assessment and action planning elements of EMS (a similar outcome was reported by Bird and Bushman 2005) finding that it gave them a sense of direction, and in some cases, allowed them to develop better measures by which to assess progress towards their own goals. Risk assessment also enhanced attention to record keeping and documentation. The latter element, although disliked, was also seen as valuable and useful. Many farmers also appreciated the development of operating procedures, which allowed them to instruct staff and potentially other farm managers, even if they were not there to do so in person (Publication 1). In addition, the iterative nature of the EMS process prompted farmers to critically examine the progress they made in achieving outcomes, leading them to evaluate a range of options and trial alternative solutions to addressing environmental and business management issues. The ability to be assessed against an internationally recognised Standard, through undertaking an external audit process was also seen as a distinguishing feature of EMS, not available through other processes such as use of BMPs

2.2.9 Sub-question 7b: Are any of the ISO 14001 elements particularly important in creating change?

Farmers generally recognised the value of the risk assessment and prioritisation process, which often served to reinforce their underlying feeling that there were indeed management areas that needed attention. In most instances, they were very

cognizant of issues that needed attention. What the EMS process added was a mechanism to act on this knowledge, do something about it, and evaluate the value of the actions taken.

Pahl et al. (2007) found that pastoralists believed writing down objectives and targets, undertaking risk assessments, monitoring and record keeping to be valuable parts of the EMS process, with 87% of participants citing 'documentation benefits' as a factor in encouraging on-going EMS use. Documentation of action plans provided a reference for future action, increased communication between spouses, prompted the seeking of new information and gave a basis for a continual improvement cycle. It appears that the act of writing in many ways provided a symbolic indication that the action was to be taken seriously, and thus the action was more likely to be put into effect.

The certification, auditing and review processes were described by some farmers as essential for continual improvement and keeping performance on track. These elements also created greater consistency in management. The requirement for documentation in an EMS in many ways created a feeling of formality amongst farmers, and for many stimulated a sense that management of the environment was being taken seriously. In addition, documenting plans and outcomes through monitoring data provided available, locatable and consistent data (Walsdorff et al. 2003) on which to base future sound management decisions. Such data meant that management decisions were not reliant on the memory of individuals for assessment of progress towards goals.

2.2.10 Sub-question 7c: Were any modification to the EMS process as described by ISO 14001 necessary to enhance on-farm use?

Similar to the findings of Wells and Galbraith (2000) who concluded that the ISO 14001 process was suitable for small business entities without modification of the process, the current research indicated that the EMS process could be applied on-farm with no major changes to the elements specified by the ISO 14001 Standard. However, the emphasis placed in elements should differ somewhat when compared to other industry sectors. Cassells et al. (2008) also observed that policy makers need to treat smaller business differently to larger business and offer greater support to SMEs to encourage EMS adoption. For example, while extensive demonstration of

compliance to legal and other requirements was not really a major concern for farmers, knowledge of compliance issues was still important, particularly for determining some objectives and targets, and in some cases, for monitoring and reporting. Communication within the farm business did not require a great deal of attention, but communication with other stakeholders took on a greater importance in the farm context.

Further, the way awareness and competence in EMS was transmitted differed somewhat between agriculture and other industries. Whereas traditional EMS-using sectors often employ consultants or linkages with trade associations to gain EMS information, farmers did not have a readily available pool of data to draw on, and agri-business and industry groups often did not, or were unable to, provide such assistance. Changes in extension, education, and support would improve uptake.

2.2.11 Sub-question 8: What were the relative contributions of people, process, and policy to EMS adoption?

The importance and creation of social change as a result of using EMS is one of the important findings of this study. The ‘people’ factor was ultimately the most significant factor in creating a successful EMS (including such issues as deciding to change, provision of support, confidence and communication). The EMS process was a necessary component as it provided a robust and credible mechanism to effect practice change. Policy mechanisms can be used to encourage EMS adoption, but more work is required to create positive incentives, rather than perverse ones, and to develop the right blend of incentives and enforcement. In general, policy mechanisms had encouraged some experimentation with EMS in Australian agriculture, but the inconsistent, patchy, and relatively short-term support provided Australia governments and agricultural industries meant that many farmers were confused about what constituted an EMS, and were unable to source low-cost support if they did want to use the process.

2.2.12 Sub-question 9a: Did using the EMS process encourage practice, attitudinal and behavioural changes amongst users and support people?

This thesis clearly demonstrated the capacity-building potential of EMS. Farmers using an EMS were more likely to seek information to address environmental issues

(Publications 1 and 2), better understand and use sustainability indicators for their own business (Publication 3), integrate diverse demands and information into routine management (Publication 4), adopt other innovations (Publication 5) and accrue social benefits (Publication 6). All of these factors led to, and supported, practice, attitudinal and behaviour changes. Changes in attitudes amongst EMS users were also reported by Pahl et al. (2007), Seymour et al. (2007) and Huhn et al. (2007) amongst others. Literature evidence suggested that these changes are likely to be long-lasting, as Bird and Bushman (2005) reported that producers surveyed some months after they had engaged with the EMS process showed a shift in appreciation of the benefits of EMS to include a greater regard for non-economic factors, with a correspondingly decreased emphasis on economic benefits. These authors suggested that the longer farmers reflected on the EMS process, the more highly non-economic factors became valued. Non-financial benefits may take longer to emerge or become measurable, and therefore may be disregarded in the early implementation of EMS, a problem exacerbated by the short funding cycles to which most EMS projects in Australian agriculture were subject.

2.2.13 Sub-question 9b: Do EMS users themselves recognise and report any changes in attitudes, behaviours, and practices with respect to farm and business management?

Farmers recognised the value that their EMSs returned to them. For example, Jim McDonald (Publication 1) when interviewed said of his certification cost, he spent “about \$2500 a year cash in maintaining it but because of the management discipline and the internal benefits, it’s money well spent” (Alcorn 2002, p.16). Case study participants noted that they had come to think about things differently to their peers, and in some cases, even saw their practices and behaviours as ahead of the thinking, and requirements, of many environmental agencies. Many of the case study farmers indicated that they took more time to think things through and to use previous monitoring and recording data in their decision making. They saw EMS as a driver of social change, focusing the user more on social aspects of management (Publication 6), and noting that use of EMS had increased communication with farm business partners, spouses, farm and agency staff. Bird and Bushman (2005) also observed that farmers who persevered with EMS development experienced improvement and increased confidence in their environmental management skills. Such attitude and

behavioural changes are inherent in culture change. Over time, many farmers who have used EMS come to recognise that their own mindsets have changed, along with their perception of environment and management practices and skills. They come to regards skills such as risk assessment, record-keeping, and communication more highly than previously, and recognise that this culture change is an important success factor for EMS implementation. However, it takes time to reach this understanding and often farmers needed to be encouraged to think about their definitions of a successful farmer and manager in a different way to their previous evaluation of these issues. These mind-set changes are indicative of the “deep intervention” in the business culture described by de Oliveira and Pinheiro (2009) necessary for change to occur in behaviours.

2.2.14 Sub-question 9c: Were EMS users in some way different to non-EMS users?

Many farmers are typically action focused, and do not recognise or articulate the process behind what they do. The use of a process focused tool such as EMS demonstrably resulted in an increase in farmers’ awareness of their business, NRM, and social management skills. However, while in theory it should be possible to track such changes in attitudes and practices in response to application of the EMS elements (which was the original intention for this thesis research), it is not yet possible to specifically attribute these changes to EMS, rather than to some other characteristics of the farmers. The elements of ISO 14001 involving review and reflection (initial environmental assessment, evaluation of progress, auditing, management reviews, monitoring and reporting progress) are those most likely to embed changes into overall management and create lasting practice changes. Some differences between EMS and non-EMS users were observed (Publication 1 and 2) in terms of attitudes to business practices, use of environmental best management practices, and openness to learning and communication, but were not tracked over time. EMS adoption does appear to be influenced by many of the same factors that affect uptake of NRM and production initiatives (Publication 5), and past studies have indicated differences between adopters and non-adopters that will most likely also hold in the case of EMS adoption. Successful implementation of an EMS is likely to depend on features and characteristics of the user. Similarly to EMS implementation, the performance of TQM approaches relies not only on the tools and

techniques employed as part of the process, but also on the “intangible behavioural factors, like leadership, organisational skills, and culture” (Powell 1995, p.28). Therefore, while some differences between EMS users and non-users were indicated anecdotally, it was still not possible to fully answer this question. At present, it is not possible to say with sufficient rigour whether EMS users are different to others. On-going research, of a longitudinal, quantitative nature, is likely to be required to determine the answer to the question.

3.0 Practical implications of the research

3.1 What leads to successful EMS implementation?

A number of factors come into play for successful EMS implementation. The decision of most farmers to adopt an EMS (Publications 1 and 2) was typically a personal choice, due to a desire to ‘do a better job’, and demonstrate the care taken of the environment, both on and off-farm. This choice can be seen as a clear expression of the ‘top management commitment’ for EMS adoption required by ISO 14001, a vital component of any EMS (Bridgen and Hjelm 2000; Cassells et al. 2008; de Oliveira and Pinheiro 2009). Gunningham and Sinclair (2009, p. 868) similarly noted this need for commitment by managers for successful implementation of OH&S approaches, stating “Indeed, it may be that management systems, like other process-based tools, are just that – tools- and genuine commitment on the part of management and with ownership on the part of the workforce”. This commitment must be supported by the allocation of resources to support the EMS (CEC 2005; Cassells et al. 2008), a clear implementation strategy (Cassells et al. 2008), clearly defined objectives and targets (CEC 2005) and robust identification of aspects and goals (Bridgen and Hjelm 2000). Embedding the EMS into routine operations is also a critical factor (CEC 2005; Walsdorff et al. 2003). EMS farmers in the case studies (Publications 1 and 2) and on dairy farms (Publication 4) all saw integration of management obligations and requirements into one management system as beneficial.

Another success factor is that of measurement of progress across all components of the business. Development and evaluation of baseline performance data prior to the start of the EMS (de Oliveira and Pinheiro 2009; Bridgen and Hjelm (2000) is important to allow changes to be assessed over time. Many of the EMS farmers included in the research for this thesis had in fact structured their EMSs to collect such data, and early targets frequently related to the collection and critical evaluation of this information. A more critical review of progress could then be applied.

Embedding the EMS in a broader context is another useful approach. Systems success was seen to be largely dependent on the manager’s abilities to accurately identify the potentially damaging interfaces between their operations and the natural

environment (Anthony 1996), and addressing impacts beyond the business boundaries (Bridgen and Hjelm 2000). To gain this broader and multi-disciplinary viewpoint, use can be made of stakeholders who have an interest in the success of environmental initiatives (de Oliveira and Pinheiro 2009) by increasing interaction with staff (Bridgen and Hjelm 2000; CEC 2005; Cassells et al. 2008), catchment management groups, neighbours and groups such as Landcare or ALMS, and investing in training, communication (de Oliveira and Pinheiro 2009) and building competency (Cassells et al. 2008). The management of environmental knowledge throughout the business (de Oliveira and Pinheiro 2009), documentation of procedures and outcomes (Bridgen and Hjelm 2000) and sharing of information therefore become critical, especially in building support for changes being made. In terms of agriculture, where staff engagement and communication is streamlined due to low staff numbers, the involvement of outside parties in planning and implementing the EMS may be more important. The involvement of outside parties allowed farmers to fill both knowledge and skills gaps within their business, and sometimes involved the use of external consultants or the creation of strategic partnerships with others able to supply the needed information or skills (as is the case for other business sectors, de Oliveira and Pinheiro 2009).

3.2 Are there specific elements of ISO 14001 that are particularly beneficial?

Some EMS users identified specific elements of the EMS process which bring particular benefits. However, not all farmers agree on the specific elements, and it is likely that the particular beneficial elements will vary depending on individual circumstances. For example, Jim McDonald (Publication 1) did not have any farm management plan that addressed all aspects of his farm situation when he began to use the EMS process. For Jim, ISO 14001 provided him with a tool to address all of his concerns at once, and so all elements were beneficial. On the other hand, the Rocky Point Prawn Farm had a marketing imperative to demonstrate their certification status, to ensure market continuity, in addition, a need to demonstrate to local regulators and the community that they were managing the farm in an environmentally sensitive manner. For them, the certification and audit process, with associated record keeping and compliance management were crucial elements.

Elements that were raised as particularly beneficial (either by the case study farmers or farmers described by other authors) are discussed below.

3.2.1 Environmental policy statements and their development

Farmers in the case studies commented that having to formulate a policy statement made them think through what it was they were trying to achieve, an outcome also noted by Bird and Bushman (2005). In contrast, Pahl et al. (2007) reported that most farmers did not like developing a policy statement and saw little benefit in doing so. Most of the case study farmers (Publication 1) either built their policy statement on existing documents, or developed one afresh, and Geno (1999) noted that policy development did not pose great difficulties for farmers. A study in the UK and Wales concluded that the environmental policy, compliance and conformance control elements led to the better use of resources (Briggs 2006), and thus logically, should also lead to improved environmental performance overall.

3.2.2 Identification of environmental aspects, risk assessment, setting targets, action planning and operating procedures

While many farmers feel they already know the environmental risks they face (Pahl et al. 2007), they often do not take concrete action to deal with these matters. For farmers using EMS, risk assessment allowed them to prioritise issues and resources, and went beyond simply identifying a problem. This element may be more familiar to farmers, as it is similar to processes in other farm management and extension programs (such as whole farm planning, succession planning and related schemes). Farmers typically were quite ‘action-focused’, and sought concrete and practical solutions. Therefore, setting targets and action planning were usually well received (Bird and Bushman 2005; Huhn et al. 2007). Action plans provided a priority listing for actions, and an on-farm ‘to do’ list. The EMS process also offered advantages over simply comparing on-farm practices against a checklist, as an EMS prompted producer-led actions to address issues. Bird and Bushman (2005) reported that participants in their study recognised that assessment without action was a waste of time, seeing the feedback loops of EMS as critical in the system functioning.

Farmers were also often familiar with technical equipment and maintenance manuals, and thus operating procedures. However, they often did not recognise that their own

on-farm practices were amenable to the same sort of description and information capture. However, farmers in the case studies and other research reported in this thesis were able to develop suitable operating procedures to describe their on-farm practices, and to detail EMS elements. In some cases, they sought reassurance in the writing and description of procedures, but most recognised the value in having a detailed description of routine tasks on-farm (Bird and Bushman 2005). This was particularly so for farms where larger numbers of staff members were employed, or in the case where a farmer owned several farms and relied on farm managers.

3.2.3 Legal reviews, evaluation of compliance

The examination of legal requirements was a two-edged sword. In some cases, farmers discovered a range of legal obligations of which they were previously unaware. For some, this provided enhanced knowledge of required actions (such as monitoring or reporting), and gave certainty and confidence regarding operations. For others, discovering legal obligations served to increase anxiety regarding compliance. Generally though, most farmers felt that the process of discovering legal requirements was useful, as it helped them avoid breaches of compliance. In some cases, they also were able to highlight the fact that they were actually performing at a higher level of management or outcomes (or both) than required.

3.2.4 Use of documentation and records to aid in management

Farmers in the case studies (Publications 1, 2 and 4) initially had mixed feeling about documenting their procedures, reflecting to some extent the findings of Pahl et al. (2007), that farmers felt time spent documenting procedures and outcomes was time 'wasted'. However, in the case studies, farmers generally came to appreciate that procedures could be used with staff and potentially replacement managers, detailing how they wanted things done, and increasing farmer confidence that tasks would be undertaken in the way they wanted, and providing the opportunity for farm owners to have time away from the farm or a vacation. They also felt that in some cases written procedures allowed better communication with staff, and also provided a training tool. In some cases, farmers were able to use their documented action plans to either defend their on-farm actions (such as use of chemicals), or to support funding applications to achieve particular environmental outcomes that aligned with catchment management authority plans (Publication 4). Corbett and Kirsch (2000)

observed that EMS implementation meant that paperwork could be streamlined, citing one company that reported a 25% decrease in the number of manuals used due to reviews and removal of obsolete data. Farmers reported similar benefits, and by taking an integrative approach, were also able to further streamline record-keeping.

3.2.5 Monitoring and reporting

Farmers involved in the research in Publication 4 of this thesis found that the EMS process increased their appreciation of the usefulness of robust and well-reported monitoring information, particularly when this was linked to demonstrating conformance with catchment targets and enhanced ability to attract funding for works. Gunningham (2007) and Huhn et al. (2007) noted the value of monitoring and assessing environmental outcomes for farmers. When linked to environmental reporting, compliance and conformance control, monitoring reportedly had the greatest influence on reduction of releases to air and water (Briggs 2006). The focus of EMS on monitoring addresses a past deficiency common to many publicly funded programs where farmers received funds to undertake environmental works. In these programs, inconsistent, or in the worst cases, non-existent, reporting of outcomes was often common, often because the programs had no clear monitoring or reporting expectations and mechanisms. EMS users, on the other hand, develop key performance indicators and monitoring programs as part of the EMS and are usually better able to demonstrate progress and justify receipt of funds to assist with on-ground works.

3.2.6 Internal audit and management review assessment, and review of progress

Farmers who participated in the case studies and other EMS research reported in this thesis were generally understanding of the need to review progress, even if they often begrudged the time and resources needed to monitor progress effectively. In other industry sectors, Bridgen and Hjelm (2000) and the CEC (2005) noted that continual monitoring and measurement and use of internal audits were critical to ensure on-going progress. While a formalised audit in the typical sense of the word was sometimes difficult to achieve in the farm context, with assistance most farmers were able to develop a relatively simple assessment of their management systems. A group approach, as used by some of the EMS Pilots, was particularly beneficial to achieve an audit of progress against targets.

Similarly, the review process was an area that farmers, while at first feeling somewhat concerned about, generally came to value, once they understood the process and what it was ultimately aiming to achieve (i.e. continuous improvement of the system). A review provided the mechanism for farmers to assess their own progress towards targets they had themselves selected. As many farmers had initially undertaken an EMS to demonstrate their land stewardship to others, the review became the means to highlight good practices and outcomes, and to assess the cost-effectiveness of various practices. The methods used to conduct both audits and reviews on-farm obviously differed to mechanisms employed in larger, non-agricultural businesses, and farmers found it useful to draw on their peers and neighbours in some cases, to conduct assessments.

3.3 Are there particular elements that discourage EMS use in the farm context?

As detailed in Publication 5, EMS uptake faces many of the same barriers to the uptake of improved NRM practices generally. Complexity of a new technology, a long time lag in benefits becoming evident, perceived high financial costs, poor perception of a new idea, low motivation to adopt, and difficulty in understanding a new technology, are common barriers to both EMS and improved NRM uptake (factors also considered by Pahl et al. 2007). However, the EMS process has numerous elements that work to overcome these barriers. Nevertheless, some elements of the process did appear to present greater challenges to farmers than others.

Identification of legal and other obligations form a central part of EMS development, particularly if a key aim of the EMS is to demonstrate legal compliance (as in the case of a business that is subject to stringent regulatory vigilance). Many businesses however can find that it can be a daunting process (Babakri et al. 2003), particularly if they are small and have limited human resources to allocate to this task (Hillary 2000). Geno (1999) and Huhn et al. (2007) reported similar findings for agriculture, with Huhn et al. stating that 25% of lamb farmers in their study said legal obligations, objectives and targets and aspects impacts should not be included in on-farm EMS implementation. These farmers stated that support and on-going facilitation was needed to assist with these elements. Many of the EMS Pilots and

Pathways studies devoted considerable time and effort to either completing a legal review, or developing resources to assist farmers in completing such a review. This is obviously an area where all small businesses (not just farms) could be provided with resources and assistance to address this particular EMS element. Farmers involved in the dairy Pilot (Publication 4 of this thesis) did not report legal issues identification as a major issue, because the work had largely already been done for them, and they were presented with a synopsis of such information at the start of the project. Similarly, the identification of environmental aspects (Geno 1999; Babakri et al. (2003), related objectives and targets (Babakri et al. 2003) and management programs can be problematic, and could be addressed in the same way.

Wells and Galbraith (2000) and Babakri et al. (2003) amongst others have reported that documentation, document control, and record-keeping presented barriers to EMS adoption. Similarly, in agriculture, record-keeping elements often appeared to be a difficult and distasteful aspect to producers (Geno 1999; Bird and Bushman 2005; Pahl et al. 2007). To overcome this, record keeping could be made easier and more palatable by providing templates that could be adapted for individual use, would be a relative easy matter.

Operational control and the development of related procedures and work instructions have been identified as elements that posed difficulties (Wells and Galbraith 2000; Babakri et al. 2003). Similar barriers were identified for agricultural application of EMS (Geno 1999; Sallur et al. 2007). In part, these difficulties may be due to lack of experience in thinking through how environmental harm could be avoided (following a process approach and root cause analysis) and, particularly for farmers, finding themselves in the unfamiliar situation of actually specifying how they perform what are generally thought of as routine tasks. Again, guidance materials (provided as generic background information) to be used as templates could overcome this difficulty. Farmers involved in the grains and dairy EMS Pilots described in this thesis (Publications 3 and 4) demonstrated a range of innovative approaches to dealing with control of environmental problems in farm, but were generally able to articulate methods of control that could be developed and refined through a research and documentation process. Once such methods were documented, they became a valuable farm resource, allowing managers to free up some of their time directing

staff (if they had them) as the procedures had been captured in writing, and were thus available even if the farm manager was not (as discussed in Publication 2).

Many farmers feared the prospect of external auditing (Geno 1999), as do many other EMS users (Babakri et al. 2003). However, once they became aware that this was an optional element of the EMS process (useful in certain circumstances, but not a compulsory element), they became more relaxed about the prospect. In fact, some of the farmers described in Publications 1 and 2, and those who participated in the Western Australian grains industry projects, initially vehemently objected to undertaking EMS audits, but later in the projects changed their minds and sought a certification audit. Corbett and Kirsch (2000) also demonstrated that as EMS users became familiar with the concept of auditing, this component became less feared.

3.4 Is a staged approach to EMS needed?

Geno (1999) suggested that a property management plan, an environmental audit, examination of compliance with environmental regulations and a strategy plan were the basic elements required for farmers to address environmental management. Others (Andrew et al. 2007; Seymour et al. 2007; Sallur et al. 2007) have suggested breaking EMS up into 'stages', with progression through awareness raising, self-assessment, environmental planning, development of a full EMS, and then certification. The numbers of proposed stages varies between writers, from four (Geno 1999; Seymour et al. 2007) to 14 (Andrew et al. 2007). It was thought that by breaking the process into 'chunks', that farmers would find it easier to move through the process, gain rewards along the way and ultimately be more motivated to continue. Seymour et al. (2006) also suggested that such an approach may make the EMS process more palatable to broadacre farmers who perhaps are under less rigorous regulatory scrutiny than more intensive farmers. The stages were described as aligning with the ISO 14001 Standard (as well as various quality assurance programs), while not meeting all the requirements of the Standard strictly enough to allow certification until the latter stages. However, by removing the linkages within the systematic approach, the overall system itself can be disrupted (Maani and Cavana 2007). In the case of agriculture, Ikerd (1993, p.155) noted that:

Farming for sustainability requires a holistic approach to farm planning and management. Whole systems have qualities and characteristics not present in any of their constituent parts; therefore, one must seek to understand the greater whole in order to understand its parts, not vice versa (Savory, 1988). Systems take on values in and of themselves through the process of synergism.

Bridgen and Hjelm (2000) discussed how various elements of ISO 14001 link together creating overall change. For example, they raised the effectiveness of documentation as a training tool, an efficiency tool, as a means for allocating and recording responsibility and as a record. In a similar vein, proposing the removal of the internal audit process as an essential component of an EMS compromises the ability to conduct a comprehensive management review, removes the need for monitoring to some extent, and prevents the collection of adequate data required for continual improvement. Thus, it would appear that leaving out elements of the EMS process ultimately weakens the overall process, and limits the benefits that can be achieved, particularly the serendipitous spin-off benefits that, while not planned for, are often achieved.

The EMS components are also common to elements of quality assurance, occupational health and safety and some food safety requirements. Inclusion of all elements of EMS promotes and supports an integrated management approach. Therefore, it is able to promote benefits beyond the parameters of the system itself, and beyond industry-specific issues, specific best management practices and Landcare-type benefits. Breaking the essential connectivity between the elements of an EMS means that overall effectiveness and thus potential benefits of the system are ultimately reduced, and therefore should be avoided.

3.5 Assessing the benefits and outcomes of EMS

The results of this research indicate that application of the EMS process in agriculture, as in other sectors, creates change, and benefits in overall management, practices and attitudes. While some of these benefits and changes can be easily measured, others are less tangible, and therefore more difficult to assess. As the initial motivations for undertaking EMS differ between externally and intrinsically motivated farmers, so too will individual measures of success. Any evaluation of EMS also needs to take into account the differences between anticipated and actual

outcomes (Carruthers 2005; Pahl et al. 2007). In many cases, the research discussed in this thesis covered EMS evaluation at an early stage in the EMS implementation, and many of the EMS Pilot and Pathways projects had not progressed into full EMS implementation before assessment of success was undertaken. At present, there are no widely agreed and established criteria on which to judge the success of an EMS that meet the needs of all parties. This is due to the differing perspectives taken of EMS (the individual users, the policy makers, industry groups and the community), the context in which an EMS is established and used, and the reasons for EMS establishment initially. For example, the diverse approaches applied during the EMS Pilots and Pathways resulted in inconsistent outcomes. In part, this was due to some projects applying only specific parts, but not all, of the EMS process, but was also due to the lack of experience amongst some project facilitators, or emphasis of the researchers' own personal interests or perceived outcomes occurring. Some of the Pilot projects set out to achieve market benefits such as increased recognition, price premiums, or market access (for example, the Bega Cheese, the Gippsland Natural EnviroMeat project, and rangelands projects of Pahl 2007; Pahl et al. 2007; Sallur 2007), while others (Reid and Ridley 2007; Ridley et al. 2007) had an emphasis on monitoring, particularly in the catchment context. Resource security was a focus for the cotton and rice industry EMS Pilots. Some of these projects employed peer review in conjunction with external auditing, while others applied a self-assessment checklist approach. These influences thus shaped the resultant use of the EMS pilot projects associated outcomes (or lack thereof), monitoring and reporting techniques.

In terms of agencies evaluating the success of programs to encourage the use of EMS, a typical indicator is the number of participants in a program. However, a paradox presented by EMS use is that if the primary aim in implementing an EMS is to gain a market advantage (such as a price premium or increased market access), then a great number of participants is not a desirable outcome, as this increases competition for market share and dilutes the impression (or reality) of superior performance. Therefore, while agencies have a vested interest in 'watering down' the requirements EMS to increase participation rates, EMS users themselves have a driver to present EMS implementation as difficult and beyond the reach of run-of-the-mill operators. One of the EMS farmers in the Case studies (Publication 1) even stated that he found himself in a dilemma when talking about EMS to other farmers,

as he believed the process was useful and vital to his business, but didn't want to encourage other farmers to take it up and thus become his competitors.

The implementation of an EMS can be assessed against the ISO 14001 Standard, through an external audit, but this will not assess the environmental outcomes that, for example, a government agency may wish to see detailed. In a few instances, market access (e.g. Abbotsleigh Citrus, Publication 1), market maintenance (Rocky Point Prawn Farm, Publication 1) and price premiums (Pacific Coast Ecobananas, Publication 1) can be directly attributed to EMS use, but this is not always the case. Achievement of a specific environmental outcome may be of no interest to a researcher interested in measures of attitudinal changes as a result of EMS.

Therefore, evaluation of EMS success solely in single terms, such as certification status, market access or premiums, financial terms, or attitudinal change alone, is clearly not appropriate for EMS. In addition, the expectations posed for EMS to be judged as a successful approach are often unrealistic. For example, Mech et al. (2003) stated that EMS as voluntary undertaking was unlikely to achieve 100% participation. However, no other voluntary environmental program in Australia has ever achieved 100% participation. To deem that the use of EMS was not successful based on less than total participation by all farmers in Australia is unrealistic.

Therefore, a combination of assessment measures is required, and the particular blend of criteria will differ depending on the evaluator and the questions asked. A new suite of assessment criteria is needed, to allow a fuller examination of EMS benefits.

It is obviously important to assess EMS benefits in context. For example, Pahl et al. (2007) believed that as the industrial sectors and intensive agriculture both have high levels of inputs, outputs, risks, and liabilities, these sectors are likely to gain more benefit from the application of an EMS than the pastoral industry, and thus the benefits, and measures of success, looked for should differ. While many farmers involved in the case studies and other research programs discussed in this thesis initially entered into EMS use seeking a market advantage, many came to realise that the majority of benefits are in the communication, training, and industry image areas. Indeed, much of the valued gained from the EMS appeared to be in areas of significant, but directly personal value – enhanced communication, improved

business sense and increased personal confidence in management. These benefits are difficult to quantify in financial terms, but appear to be invaluable to the individual.

In assessing benefits accruing during various EMS projects, it was obvious that benefits did not receive equal attention in assessment. The expectations of the assessor (as discussed in Publication 3) influenced the assessment of EMS success. Frequently, the only evaluation applied was that of the creation of price premiums or similar market advantage. Many of the metrics applied in the EMS Pilots were strictly financial, for example. If this primary evaluation did not reveal a price advantage, then assessment frequently went no further. This was despite the numerous anecdotal reports of other benefits arising from EMS use. While social outcomes were observed frequently, these are often not given the same weight as financial outcomes. Yet as Publication 6 in this thesis shows, the EMS process promotes a range of social outcomes that are valued by farmer participants, even if not well recognised by EMS users and others. In many cases, the metrics were not readily available against which to measure non-financial outcomes. The lack of suitable benchmark data, or even general production data, on many farms was also problematic. Many farmers did not keep good records prior to EMS implementation, and so had nothing against which to accurately measure progress. Often one of the first tasks in a farm EMS (observed in the case study farmers reported in Publication 1) was to establish baseline measurement of various environmental indicators on-farm.

The scale and tangibility of outcomes from EMS implementation did certainly differ amongst users. For many farmers, indicators required by agency staff to assess the outcomes of involvement in an EMS research program were simply not relevant to their own ability to evaluate on-farm management (as discussed in Publication 3). Data of most use to farmers frequently did not supply the level of information needed by agency staff to evaluate policy developments. As discussed in Publication 3 of this thesis, the EMS process can be an important guiding factor in the development of relevant indicators that allow the user to tailor not only monitoring, but also reporting and guide indicator selection. The intangibility of outcomes also poses numerous policy issues. For many years now, the policy agenda in Australian NRM has tried to support the building of capacity and resilience amongst farmers. The use of EMS certainly prompted many farmers to have increased confidence in their management, develop a wider range of communication, consultation, and

information sources. However, these features, while building capacity are quite difficult to measure.

The attribution of benefits directly to EMS is also problematic. Many of the environmental outcomes achieved by farmers using an EMS could have been achieved in isolation without the use of a systematic approach. However, the question really is: ‘Would the environmental outcomes have been achieved without the EMS?’ Pahl et al. (2007) stated that many of their farmer participants felt that they already knew the environmental issues facing them would suggest that knowledge of an issue does not translate into action to address it, with the considerations discussed in Publication 5 likely to come into play here.

Finally, for many of the EMS Pathways projects, assessment of EMS success was complicated due to the lack of consistency between many of research projects. Many of the programs developed were not related to EMS as such, but a range of BMP approaches. Therefore, definition of the issues addressed (management or environment related) was lacking, and provided no grounds for comparability.

To overcome some of the difficulties in quantifying EMS benefits, assessment should address, at a minimum, management system improvement, enhancement to organisational reputation and/or financial benefits (Briggs 2006). In the agricultural context, issues such as improved environmental performance (including off-site impacts), compliance and quality assurance, improved relations with regulatory bodies, community groups and other interested parties, cost savings/cost avoidance, and where relevant employee training and awareness, would form core elements to be assessed. In designing evaluation criteria for EMS, or indeed any other program aimed to in enhance NRM, an assessment of the following factors would be required:

- Does the program have a capacity building potential?
- To what degree are reflection and review built in to the program to encourage and reinforce behaviour change?
- Is the program sufficiently flexible to deal equitably with social, environmental and financial issues?
- Does the program provide the ability to achieve multiple, and diverse levels of goals (for example: are personal as well as public policy goals achievable?)

The benefits arising from EMS implementation will change over time as the EMS matures, targets change, and tangential outcomes are addressed. Many of the EMS Pilots and Pathways Projects determined the anticipated benefits from EMS use at the commencement of the projects. Projects then ran for between 12 and 24 months and often ended at the point of initial development of a plan to implement an EMS (that is, not full implementation). Project participants were usually then surveyed again to assess the benefits of EMS use. However, examining the experience generated in other industry sectors suggests many EMS benefits take much longer to emerge, and are often not identified or assessed early on. Therefore, it is likely that the short-term EMS Pilots and Pathway in reality simply did not continue for long enough for many of the EMS benefits to be developed, recognised, or assessed. The assessment of EMS is not a static endeavour, but one that should be on-going.

4. 0 Residual questions

Does partial involvement in EMS create any improvements for management and the environment? Work by Bird and Bushman (2005) Pahl et al. (2007), Ridley et al. (several papers), Huhn et al. (2007), and Seymour et al. (2007) would all seem to indicate that the answer to this is 'Yes'. While none of these studies utilised the full range of EMS elements as described by ISO 14001, benefits such as an increase of general environmental awareness, and some progress towards strategic and effective business planning and management were reported by these authors. Experimentation in removing or downplaying certain EMS elements and evaluating the effect on the success of the residual elements in promoting change would prove to be a fruitful research area. Comparison of these benefits to those gained by using a full EMS process is warranted. Similarly, gaining an understanding of the reasons for withdrawing from EMS use (whether following the development and implementation of a 'full' or only a partial system) would shed further light on additional barriers and constraints that may not become evident in the early phases of EMS implementation.

Determination of the initial starting point for EMS (in terms of environmental and business performance) along with a longitudinal study to assess changes in attitudes, behaviours and performance created by the EMS process are important future research areas. Such data would provide valuable information on how to encourage and motivate changes in performance and practices.

A comparison could also usefully be made between farmer EMS use and that of other small enterprises which represent combined home/business environment. For example, eco-tourism ventures, where community expectations of environmental stewardship are placed on businesses where the home is also the workplace, could be studied in this regard.

5.0 Recommendations

The EMS process leads the user through a series of iterative steps. These steps can alter the frame of thinking of the user. However, different users will approach using the tool in diverse ways, influenced by their past experience, and thus the use made of, and the outcomes from, EMS will differ. Creating an encouraging atmosphere for EMS uptake and implementation (through policy, and other instruments) and building farmer capacity for EMS adoption therefore is dependent on gaining an understanding of how farmers approach the EMS process and how the process influences their business and environmental management. Gunningham (2007, p.304) noted for successful use of voluntary environmental management arrangements such as EMS that:

The key is to find the right mix of incentives (legal, economic, market based, reputational, etc) for specific national contexts. If we fail to do so, then mechanisms such as EMS, which have the potential to make a very substantial contribution to sustainable agriculture, in practice, may fail to do so.

This study highlighted a number of areas where judicious support of the development and implementation process could provide greater encouragement and incentives to implement an EMS. A number of recommendations to enhance EMS adoption in agriculture are provided below.

5.1 Apply a consistent approach to EMS

The National Framework for EMS in Agriculture (SCNRM 2002) recommended the use of ISO 14001 as the basis for EMS development. This approach was departed from in the National EMS Implementation Plan (NRMMC undated), where a much broader definition of what constituted an EMS was applied. This created a great deal of confusion and uncertainty amongst farmers and industry groups, with subsequent reluctance to embark down an ISO 14001-based EMS path if government recognition and support was not going to be available. Whilst EMS pathways project participants reportedly appreciated the flexibility provided for them to develop industry relevant approaches to EMS, some of them saw a need for government coordination of the various approaches, positioning them within a national framework aligned to catchment and state targets (Hassall and Associates 2007a). This provided the

possibility of having various approaches approved to provide the basis for the provision of incentive funding to participating producers.

Consistency in the definition of EMS, best achieved by reference to, and application of recognised standards for EMS implementation (Bridgen and Hjelm 2000) would facilitate adoption. By recognising and applying relevant Standards, the current confusion regarding EMS and resulting lack of uptake by farmers could be avoided. Therefore, the Federal Government should re-examine the National Strategy on EMS (which provided an agreed definition of the term EMS), and consistently apply this to future EMS funding and research.

5.2 Use a blend of policy and other instruments

Use of a blend of policy instruments could play a greater part in EMS adoption. Increasing the linkages between various regulatory measures and incentives (cross-compliance) would be effective in supporting EMS adoption (Gunningham 2002; 2007) meeting a range of regulatory requirements while providing a framework for producers to organize and document their participation in programs (Bird and Bushman 2005). For example, Mike Logan (pers. comm. 2000, Canberra) stated that if governments had linked access to either irrigation water or ability to purchase and use chemicals on cotton farms to those who had an EMS, “You would be knocked over in the rush” of farmers seeking to develop and implement EMSs. Access to resources was seen as a stronger driver for EMS uptake than market drivers (Andrew et al. 2007), with such drivers “strengthened by requiring cross-compliance for landholders to meet requirements from government or industry as a condition for access to funding from existing programs, and for access to key water and land use resources” (Andrew et al. 2007, p.253).

Implementing an EMS program prior to imposing new legal environmental requirements provides a means to achieve a desired outcome at a cost lower than development and enforcing legislation (Bird and Bushman 2005), allowing farmers to demonstrably address regulatory compliance issues (Pahl et al. 2007). However, in reality, many Australian farmers are not subject to particularly stringent regulatory scrutiny, and so while fear of increased regulation or levels of compliance was a

recognised EMS driver, compliance was not often realised in actuality (as shown in Publications 1 and 2). Very little active scrutiny occurs of on-farm behaviour, and only large operations (usually livestock based) trigger either licensing or inspections and audits. In addition, the use of an EMS cannot be mandated as EMS adoption is voluntary (a point stressed in the ISO 14001 Standard). Thus, the suggestion of Bird and Bushman (2005) to allow for regulatory flexibility and reduced compliance efforts (such as less frequent monitoring or reporting) for EMS users who do fall under a regulatory regime – typically intensive livestock producers – may serve to make EMS adoption more attractive to only some farmers. It is unlikely that increased regulatory pressure will have a great effect on farmers who currently are not triggering reporting or monitoring requirements, such as broadacre or extensive grazing operations. Therefore, combinations of policy instruments will be necessary.

Gunningham and Sinclair (2009) observed in the case of OH&S system implementation in the mining sector that trust, ownership of systems, and voluntary cooperation between managers and government regulators resulted in greater adoption of the ‘spirit’, rather than the ‘letter’ of the law, and would presumably lead to a more outcomes focused result, rather than a compliance for compliance sake result. The development of trust and collaborative understanding of what an EMS is and can do for agriculture will take time, and this factor must be considered in development of government and industry support programs for EMS.

Mechanisms such as providing regulatory flexibility between programs, acceptance of paperwork and documentation from one program to meet the needs of another, and recognition of outcomes achieved by means other than those prescribed in various best management practices are all ways in which enhanced integration between programs, and recognition of outcomes could be achieved.

Compliance also needs to be considered in the social context in which it is applied. For farmers, the issue may not be so much regulatory compliance, but community, industry or peer compliance, with related issues of social acceptance and belonging being more important. Peer pressure and a desire to show that they are ‘doing the right thing’ seems to be a much stronger motivating factor. This may be one reason that group development and implementation of EMSs seemed to work better than individuals acting alone. Not only does the group provide support, but there may also

be subtle group pressure applied, particularly if tied to a marketing block arrangement (for example the Gippsland Natural beef and lamb producers, the Ecobanana growers and possibly the Australian Landcare Management Systems groups). Competition between growers needs to be carefully managed in these cases – for example the Living Wine Group in New Zealand had to agree that certain topics would be shared, and that other issues would be kept confidential.

5.3 Establish better baseline data and benchmarks

The development and sharing of environmental and business performance outcomes to enable enhanced benchmarking of performance within agricultural industries is an important feature that is currently absent in most Australian agricultural industries. There is a great need to establish and evaluate features critical for successful on-farm NRM and benchmark these before EMS implementation begins. In many cases, in the studies reported on in this thesis, there was very poor baseline data against which to evaluate progress (similar to the US, see Bird and Bushman 2005). Supporting the development and publication of industry benchmark data for environmental issues could be undertaken by individuals, by industry groups or agencies, or preferably as a collaborative effort between the two, to support EMS uptake.

5.4 Develop better measures of EMS success

As discussed in Section 3.5 above, a new way to evaluate and measure outcomes of EMS adoption is required. Governments have a role in providing clear environmental performance standards specific to agricultural industries (Anderson et al. 2001; Mech et al. 2003) to provide benchmarks against which to frame targets. Community members could become more engaged in determining target issues to be addressed with an EMS on-farm, through increased dialogue with agri-industry groups, catchment management groups, or retailers of fresh produce. Industry groups can also determine realistic performance standards that go beyond the base level, minimum performance expectations. While these standards could be used without EMS, the EMS process would assist in implementation of changed practices, and

provides a mechanism by which the implementation can be assessed (through internal review and audits).

Qualitative and quantitative research to examine the linkages between EMS, changes in environmental management practices, and environmental outcomes is required.

Performance based reporting is also a means to achieve public sector reform and efficiency (APSC 2007) for NRM. Farmers can assist in meeting this need for data with the increased use of EMS, focused on outcomes achieved along with review of progress. However, use of pre-set performance measures without regard to the situation in which they are being applied (to meet pre-specified indicators) decreases the flexibility needed for adaptive management and can distort outcomes, reducing the possibility of interaction with other programs (ASPC 2007). Therefore, careful selection of indicators of performance is required, as discussed in Publication 3. The establishment of streamlined evaluation and reporting mechanisms for farmers to more easily contribute data to NRM management agencies will greatly assist in the development of NRM policy, and would be assisted by a consistent approach to risk assessment and data collection. Clear identification of relevant environmental issues, and the criteria used to determine risk would be enhanced by EMS use.

5.5 Encourage EMS development

5.5.1 Address lack of EMS awareness

Awareness of a management system and its elements is needed by the user before they can fully embrace the concept. Many farmers often not aware of EMS, nor that it could present them with many opportunities for enhanced management. Many agency staff, industry representatives, farm consultants and advisors typically are largely unaware of the EMS Standard, and have little experience in its development and implementation. Provision of agricultural-specific EMS information would assist in addressing this lack of awareness, to some extent. Awareness and implementation of EMS principles within government itself would also assist, providing a more strategic approach to the development of targets, monitoring, reporting and communication of environmental outcomes for agriculture.

As with other areas of innovation, positive success stories are influential in encouraging adoption, and as the pool of farmers using EMS expands, so too will the information and case studies of their experiences. The environmental, social, business and financial outcomes of EMS adoption need to be made more widely available. Publications 1 and 2 were specially designed to address this issue, but further work is needed. Government agencies and industry groups can play a major role in support the collection and publicising of producers' EMS stories in order to attract and encourage others (Bird and Bushman 2005). The capture and dissemination of such information and use of reported outcomes in on-going policy development is required. Potential users of EMS need to be provided with accurate and timely information on how the EMS process works and the outcomes that can be achieved. As adoption increases, the spill-over effect of adoption of changed practices noted by Pannell et al. (2006) will increase familiarity with EMS, enhancing adoption further.

5.5.2 Gain and promote a better understanding of EMS in the agricultural context

Gaining an understanding of the implications and barriers for EMS adoption in agriculture, better knowledge of specific environmental issues farmers face, the practicalities of EMS auditing in a farm situation and cost structures for small/micro business are all essential areas of research and development, to overcome issues associated with EMS use on farm. Some countries have addressed these issues through the development of agriculturally relevant, sector-specific guidelines for EMS development and implementation, supporting this with training for consultants and auditors in agricultural-relevant issues. One of the aims of the EMS Association in Australia is to increase interaction between sector groups of EMS users, to facilitate co-learning and to overcome the isolation of some groups. The engagement of EMS auditors, consultants and Standards bodies is essential to create such a co-learning atmosphere.

The language and terminology of the ISO 14001 Standard has been criticised (Pahl et al. 2007 amongst others) as creating a barrier for farmer adoption of EMS. Further, the current consultative group charged with development, refinement and review of AS/NZS ISO 14001 in Australia has no representative providing input from the

agricultural sector (although forestry and mining are both represented). Agricultural considerations, therefore, unsurprisingly, are under-represented in the review and refinement of the Standard, which creates difficulties for farm consultants and auditors when it comes to application on-farm. Greater interaction with Standards bodies to develop appropriate standards and materials relevant to the industry sector is required. Standard developers and auditors generally do not have agricultural experience, which means that Standards development processes do not give adequate consideration to agricultural issues. Active engagement of agri-political bodies in Standards development is required, to ensure that agricultural issues are considered in future standards development.

The interaction of EMS with other business management practices, and its value in evaluating available information should also be highlighted. While government support for the development of environmental codes of practice, best management practice manuals and similar information has been advocated (Mech et al. 2003), farmers in the case studies and other projects detailed in this thesis (Publications 1, 2, 3 and 4) often noted that they had too much information. They noted that EMS provided a means of filtering, allowing them to streamline management and target the most relevant information for themselves.

5.5.3 Increase general and specific EMS information

There is a clear need for not only education and training about the EMS process (Gunningham 2002), but also for information to highlight the benefits EMS can bring. Governments, standards and certification bodies, and industry groups should work collaboratively to develop and such information, with all aspects of management addressed, not just production-related issues in isolation.

To overcome the language/jargon issues of ISO 14001 previously identified as a barrier to adoption, the development and provision of information to assist meeting specific EMS elements would be useful. Resource intensive information areas such as current legal obligations and solutions to regionally specific environmental issues, for example, are high priority information areas where support could be provided. Improved risk assessment techniques, enhanced monitoring programs and integrated and streamlined reporting to policy agencies are other potential areas for support. Where there is a need for particular sorts of information on behalf of NRM agencies,

clearly identifying these areas for reporting and overcoming the barrier of poor record keeping (Reith and Guidry 2003; Walsdorff et al. 2003) form an area where assistance could be supplied to overcome this deficiency.

Developing tools that were readily adaptable to suit an individual's particular circumstances (Bird and Bushman 2005) will be an effective means to assist EMS development. This is evident not only from the agricultural case studies described in this thesis, but holds true for other industry sectors. Production of a model EMS for each agricultural sector (as done for the grains industry as discussed in Publication 3) would provide stimulus material for farmers wishing to develop an EMS. Aligning and supporting these materials with existing industry-based information is a sensible approach to take, and was used where possible in my own EMS research (for example, as detailed in Publication 4, with the dairy industry). However, models and templates need to be clearly presented as examples only, and not demand absolute adherence to using example materials. Over-reliance on templates can interfere with an individual's ability to think through the EMS process and adapt management approaches for themselves. As government provision of information is likely to be treated with suspicion and not readily taken up, industry bodies have a significant role to play in developing and promoting these models and case studies of their use to assist with more widespread EMS implementation. Government agencies, however, could assist by funding research into, compilation and publication of such information.

5.5.4 Improve EMS training and extension

The decline in provision of free extension services across Australia (Vanclay and Lawrence 1995) is also of concern for EMS adoption. Many EMS Pilot and Pathways projects reported that there were limited sources of accurate information on EMS, and most noted that the EMS projects had provided considerable assistance in this area. Farmers need not only knowledge of EMS, but also how it can interact and build on other programs, and how to best use and adopt the process for their own operations. Incorporation of systems management thinking into other agricultural training programs will not only assist in EMS uptake, but also enhance other training. For example, climate change adaptation training provided in Australia at present is underpinned by risk assessment processes. The chemical management courses

usually provide examples of improved documentation development, management, and control. Therefore, it is prudent to draw out, and draw on, the systems elements of EMS (risk assessment, documentation and record keeping, operational control and similar) that are also common to other programs. Highlighting to farmers that they have often already implemented at least some of the elements of EMS will ease the transition into a more systematic approach to management, and allow EMS users to build on practices and processes that they already have in place. A focus on the business (CEC 2005) and all components of its management should therefore be a key area for attention by EMS facilitators to assist in adoption.

Improved EMS information provision relevant to farmers has been called for by numerous authors in Australia and overseas (Carruthers 2003a; Ridley et al. 2003; Bird and Bushman 2005; Pahl et al. 2007; Seymour et al. 2007; Ridley 2007). Specific training for EMS facilitators and extension officers is required to support this. Studies have observed that few agricultural educators understand EMS, very few trainers or producers have direct EMS experience, and environmental management *per se* is rarely included in agricultural training (Bird and Bushman 2005). The work I undertook while with NSW DPI aimed to address these issues in Australia, and to correct these deficiencies here. However, very few other EMS researchers had the same role, effectively limiting the number of farmers who could be mentored through the EMS process. EMS facilitators should, where possible, also engage in EMS implementation with a range of industry sectors, as such experience is invaluable in providing materials that can be adapted for agricultural use. Mentoring between EMS facilitators is a useful means to enhance experience and background skills, and could be supported by both industry groups and agencies.

The sort of information sought by farmers and the sources of this information are likely to change over time, as their EMSs develop. This has been observed during other practice changes amongst farmers (Kilpatrick et al. 1999). There are also some issues regarding who might be seen as the expert at various times during the EMS process and implementation, as the sorts of changes made when using an EMS will cover not only practical on-ground changes, but also record-keeping, tactical/technical changes, other strategic changes or even new enterprises. Experts are used most often in learning-for-change situations, with Government consultants the expert source most often used (Kilpatrick et al. 1999). The right people to deliver the right

message (trusted, recognised by the audience, and typically from within the industry sector itself, not be government staff or ‘experts - Gunningham 2002) are needed. Extension services need to recognise and provide for these different information needs throughout the EMS process. An important attribute for EMS facilitators is the need to be able to span boundaries (Klerkx et al. 2010). As the range of issues and thus required information for EMS is potentially so broad, it is highly likely no one provider or source will cover all that is needed for EMS development in any sector. Thus, coalitions between potential information providers on EMS would seem appropriate in order to cover the vast range of topics that could be included.

Educational programs on EMS, in addition to simply presenting the various elements of ISO 14001, should cover environmental assessments, environmental policy, and the integrative and documentative capacity of EMS to address compliance matters (Bird and Bushman 2005). Information presented needs to be practical, relevant to the decision-making at the farm level (Mech et al. 2003, p.3) and related to landscape scale targets on specific issues that could be translated into on-farm actions as part of an EMS (Carruthers 2007; Ridley et al. 2007; Reid and Ridley 2007). Educational and extension strategies about EMS should possibly also differ between small and larger producers, to accommodate the different barriers perceived for EMS uptake between these groups (Bird and Bushman 2005), and further may need to specifically target different industry sectors individually in order to allow specification of particular information.

5.5.5 Use both group EMS development and individual mentoring approaches

Reassessment of farmers some months after the completion of their respective projects (Anthony 1996; Pahl et al. 2007; Sallur et al. 2007) noted that many had made no more progress on their EMSs since the group sessions had concluded. These observations suggest the utility of a group approach for EMS development, and highlight the need for on-going attention to an EMS in order for it to move ahead. Working with small peer groups using a workshop format for training and involving a range of stakeholders in such training, is important for enhancing EMS uptake and provision of group support for EMS may provide an incentive for farmers to adopt EMS (Schulman et al. 2000; Pahl et al. 2007; Seymour et al. 2007). The withdrawal of extension services in Australia has resulted in the greater use of group training

sessions to deliver NRM information and it is likely that EMS extension will follow the same path. Group development and implementation of EMS may be effective in creating on-going support mechanisms helpful in maintaining momentum in the absence of strong external drivers (Sallur et al. 2007). In addition, the development of a 'culture' of EMS acceptance is likely only to be achieved in a group context, unlike the potential for within-business culture development noted by Gunningham and Sinclair (2009) in the case of OH&S systems in the mining industry.

Group interaction promotes the sharing of information, provides mutual motivation and allows comparison of practices and benchmarking (Walsdorff et al. 2003). Group EMS development can also mean reductions in development and auditing costs (Riddiford 1999; Ammenberg et al. 2000; Schulman et al. 2003). Groups EMS development also assists farmers to leverage greater support, and can provide the basis for marketing blocks, if required (in cases of bulk supply situations where supply quantity and continuity can be important market access considerations). However, the Australian government would not approve EMS Incentive Program payments to farmers who had decided to pool their resources, and as a group, employ an EMS advisor. This meant that federal approaches to payments meant to encourage EMS actually blocked one of the key areas where progress could have been more easily achieved. Should government support for on-farm EMS development be reinstated in the future, approval of allocation of pooled resources and incentive payments will be an important encouraging factor.

It is likely that group EMS development will not be appropriate in all cases. Group work may be more important in early stages of EMS assessment, evaluation and development, providing peer support when farmers are contemplating major practice changes and making up their mind to get engaged. However, group work may not be appropriate later on when farmers are fine-tuning the EMS to own farms, and needing individual support and assessment. Consistent and individual coaching by credible and committed coaches was found to be useful to keep producers on track in on-going development (Bird and Bushman 2005). Therefore, a flexible approach on behalf of government agencies providing support for EMS training and facilitation, and a recognition by farmers and industry groups that there may be a need for individual (privately funded) consultation is required.

5.5.6 Reduce fear of regulatory creep

Fear of an ever-increasing burden of legislative compliance is an issue farmers sometimes expressed at the start of using the EMS process. This came about largely due to the interpretation of the requirement in ISO 14001 for a commitment to ‘continual improvement’ as meaning ever-higher levels of regulation could be imposed. In reality, this refers to the improvement of the system itself, due to reflection of progress and adjustment of system elements over time, which may lead to increasingly higher levels of environmental outcomes, but not necessarily regulation (there is no clear causal link between **improved** performance and increased regulatory scrutiny – rather increased scrutiny may be prompted by poor outcomes). This fear of regulatory creep as a consequence of EMS use forms a barrier to EMS adoption. Lack of direct knowledge or accessibility to environmental legislation exacerbates the problem. Many of the farmers included in the studies detailed in this thesis found that when access to, and interpretation of, environmental legislation was available, they could determine that they were often achieving higher standards of performance with regard to mandated outcomes than they had previously thought. Many of the EMS Pilots sought to provide this sort of data, and it was welcomed by farmers, but with the removal of funding, most of these resources are now out of date and once again, unknown. There is a clear role for both governments and industry groups to increase the overall understanding of legislative requirements, through provision of more accessible and understandable interpretation of requirements. Enhanced extension services and awareness programs would also assist in overcoming this barrier.

5.5.7 Make better use of incentives for EMS adoption

While financial support has been shown to encourage adoption of improved practices and EMS across a range of issues, such support can achieve greater levels of adoption if it is better targeted to meet the specific needs to adopters. Provision of information, technical assistance, subsidisation or tax credits, and audit protection (i.e. not penalising businesses who uncover less than satisfactory performance during initial reviews or audits while developing an EMS) have been identified as key areas of EMS cost reduction that could be provided by governments (Coglianese 2001). In the case of agricultural EMSs, the provision of mentoring and support services is

often more desired (Pahl 2007) than support for on-ground works to meet public policy outcomes, but not individual farmer needs. Striking a better balance between the needs of the adopters and the outcomes desired by agencies is required through more flexible determination of target areas and outcomes. Linking use of EMS and access to other benefits, or access to resources (Schulman et al. (2003, Carruthers, 2003b) has been suggested as a strong incentive to use EMS.

Both government and industry support are likely to be required for EMS in the absence of strong market (and internal) drivers (Pahl et al. 2007). However, provision of funds to assist with EMS adoption through the EMS Incentives Program (EMSIP) was not been handled well in Australia. While there was initially substantial government agency investment in EMS research, the EMS Incentives Program diluted the focus from EMS adoption *per se* to mechanisms or actions taken on-farm that were already supported by other support payments. EMS Incentive Payment (EMSIP) funds were provided for actions that were not in fact related to systems management approaches, but rather to BMPs. Further, EMSIP funds were frequently provided for on-ground and/or capital works, while assistance was not provided to support EMS development areas – notably support, EMS technical information and examples, mentoring and coaching. The ‘watering down’ of EMS in many of the Pilot and Pathways projects, removing elements associated with planning, training, reporting, review and reflection activities, and/or verification of outcomes, served to both remove the elements most likely to reinforce individual capacity to change and reduce the credibility of outcomes achieved. Therefore, while payment of incentives early in the EMS process could serve as an initial encouragement to ‘invest’ in the EMS process itself (Bird and Bushman 2005), giving support at the time of greatest management change, these payment need to be clearly tied to EMS use and not other issues.

A further complication with providing payment to engage in EMS projects can be seen from the experience of the EMS Pilot and Pathways projects. Farmers would engage with the EMS process for as long as the external funding was provided to do so, and agency staff were available to help (for example, see Pahl et al. 2007). However, they were less inclined to continue with EMS if they received no free assistance (in the absence of market reward). In addition, the amount of money offered to landholders under the EMSIP program was minimal. In many cases, the

potential support achieved through the EMSIP program was much less than could be accessed through other programs not requiring the degree of change needed to gain EMSIP funds. EMSIP funds were allocated on a once-off basis, and did not provide assistance with on-going implementation costs of EMS – a factor Pahl et al. (2007) identified as a barrier to EMS implementation. Other sources of financial incentives may be more viable in encouraging change. Reduced insurance premiums for EMS adopters could provide longer-term financial incentives (Bird and Bushman 2005), as could provision of access to resources, information and/or funding to deal with more intractable environmental matters (Pahl et al. 2007). Other longer-term encouragement factors included tax and rate relief, assistance to deal with both on- and off-farm environmental issues, and reduced licence fees where applicable (Pahl et al. 2007).

Recognition and reward for businesses which have an EMS (Florida 1999; Florida and Davison 2001; Bird and Bushman 2005) could be achieved in various ways. Recognition of the certification status confers a level of reliability for EMS users, and removes the need for extra (costly) communication to consumers that can be an issue for poorly known/recognised BMP approaches. For example, while soil salinity is a major issue for some areas of Australian agriculture, it may not be of concern to international consumers, who while having no knowledge of the impact of salinity in Australia, are interested in the environment generally. EMS can help streamline communication, and convey the image of land stewardship and ‘green’ behaviour, without needing to detail the specific issues addressed through the EMS. The use of internationally recognised Standards provides an additional benefit to EMS users. Community members therefore could use the EMS status of producers to direct purchasing their power, supporting those farmers who are demonstrably assessing a diverse range of environmental issues through use of an EMS.

Many Australian EMS researchers, however, have limited their thinking about ‘recognition’ solely to that provided by market premiums (e.g. Ridley 2007; Sallur et al. 2007; Seymour 2007) and have ignored the implications of other forms of recognition. Recognition, rather than opposition, for EMS adopters as industry champions and leaders (as occurred with Mike Logan, and Frank and Dianne Sciacca – see Publications 1 and 2) would be a positive support for EMS. Industry groups could provide for peer support and accountability, for example, by supporting a

producer-led EMS networks. Assistance for EMS farmers to identify markets interested in green product lines, limiting access to certain resources to farmers who can demonstrate through their EMS, responsible and efficient use of those resources, acceptance of the EMS process as a ‘paper trail’ to demonstrate stewardship (Bird and Bushman 2005) and a range of compliance relief measures (where appropriate) are also appropriate methods of recognition are mechanisms governments could employ to support EMS uptake.

From a community and professional aspect, the EMS Association has established a range of awards, including a farm category, specifically to provide recognition to EMS users, in the same way as Landcare, Conservation Farmers, and similar awards have been developed. Very little development has occurred in the development of recognition for EMS users, and this area remains ripe for further initiatives.

Finally, members of the community who use EMS in their own businesses are increasingly examining market chains linkages as a way of enhancing their own EMS implementation. Conceivably, such links could be extended to agricultural producers, either through eco-system services provision (e.g. to provide off-sets for vegetation clearing in the case of developers), or as suppliers of other services that may be relevant. Government could play a significant role in EMS adoption, by enforcing green procurement practices, ensuring that purchase of agricultural produce for any government facilities (such as hospitals, orphanages, and similar) is predicated by whether the produce or commodity has been produced using demonstrably sustainable practices, proven through use of an EMS.

5.5.8 Remove perverse incentives

There is a need to remove perverse incentives for poor environmental performance. Revision of regulations to “eliminate the disincentives to adoption of advanced practices and to stop in effect subsidizing problematic behaviour” (Florida 1999, p.4). Penalties for environmental harm need to be aligned with the costs of making radical behavioural and practice changes, to avoid the situation where it is cheaper to continue to cause environmental harm, and pay small fines than to invest in change (Florida 1999). Similarly, provision of support to farmers in adverse conditions such as drought or flood should also take into account whether active management to proactively plan to address such issues had been undertaken. For example, the

provision of support for farmers to address the impacts of overstocking should be linked to demonstrable steps taken to avoid an overstocking problem in the first place – such as pasture condition monitoring, soil testing, water conservation, and judicious destocking when routine monitoring indicates a downturn in pasture availability and/or condition. Removal of perverse incentives (Schulman et al. 2000) in favour of strategic approaches for management such as EMS would support adoption.

5.5.9 Ensure on-going critical reflection and reporting of EMS outcomes

Encouraging the critical review of EMS performance (by both individual users, industry groups and by government/communities) will be essential in continuing to improve the process overall. Information so generated could be used to develop the principles on which overall system development and implementation could be based (as advocated by Black 2010, with regard to critical reflection on the behaviour of financial institutions and the development of principles-based regulation).

Certification audits are one way of demonstrating continuing EMS support and implementation, with third-party audits described as the ‘conscience’ of the business (Brigden and Hjelm 2000). Farmers in the case studies (Publication 1) expressed similar views. While undertaking an audit was not seen as a particularly enjoyable experience, the value of doing so was recognised by farmers. Even if they were not seeking certification status, value was placed on having an external party evaluate progress, in part because such evaluation added credibility to claimed outcomes (Bird and Bushman 2005). The Gippsland Natural group recognised this and supported third-party auditing for the group, without the full certification auditing process being applied. To assist in the on-going critical reflection and reporting of EMS outcomes, farmers and industry groups could collaboratively undertake external audits, thereby reducing the individual costs of auditing and making it more applicable in the farming context. Certification bodies should develop more agriculturally-focused auditing procedures, and develop greater experience with the agricultural sector, as a means of streamlining audit processes and reducing costs. Similarly, the development of improved outcomes-based reporting mechanisms, rather than focusing solely on the results of certification audits, is needed.

There are roles for government, industry, community and individuals in assisting with enhanced EMS awareness and extension, adoption, review and reflection. The above recommendations offer some suggestions to assist in increased adoption of EMS, but do not cover all potential areas. As with the adoption of other NRM and practice change programs, long-term and consistent support will be needed to maximise change.

6.0 Conclusion

The EMS process is a powerful tool that so far has been under-exploited in the context of Australia agriculture. While this study has shown that EMS use can create substantial changes in the management approach used by farmers, inconsistent government policy, and insufficient industry support meant that the full potential of EMS to drive natural resource management change in Australian agriculture has not been achieved. Farmer uptake has been hindered by reversals in government policy, lack of trained facilitators and inconsistent provision of support services. Industry drives towards the development (but not necessarily adoption) of best management practice approaches, with mandated performance, but not management process, outcomes have further hampered the adoption of systems approaches.

Assisting farmers firstly to adopt EMS, and gain an appreciation and understanding of the benefits, is intensive in terms of facilitation, and thus resource-limited (due to low numbers of EMS facilitators currently available in Australian agriculture). This forms a classic case of where support from agencies is needed on an on-going and adaptive basis, in order to cope with the changes in demand farmers will have for support as their EMSs grow and mature.

Outcomes from this research can be utilised to ensure that the potential of EMS to drive management change is captured, and driven further in the future. The results of the thesis are of use to those who assist farmers to make a change to more systematic management – extension staff, industry development officers, and agency staff, particularly those looking for a sustained practice change. However, the results are also applicable more widely to small business owners considering EMS adoption, as many of the issues identified in this thesis are common to other sectors.

This thesis has also demonstrated that the use of EMS on farms can bring wide ranging benefits not only to the user, but to the wider community. Of particular benefit is the way the EMS process stimulates dialogue between diverse parties, and enhances the capacity of land managers to identify, embrace, and adjust to change. EMS provides a strategic and systematic mechanism to address social, environmental and business issues in a risk-based and positive manner, relevant to each user. With ever-increasing complex and rapidly changing requirements placed on agriculture,

embedding the capacity to address environmental, social, and financial considerations in all decision-making processes of businesses and governments is critical to ensure flexible and effective management can take place. The use of EMS as a means to achieve such capability for farmers offers a great potential to achieve significant business and societal outcomes, as well as enhancing environmental outcomes from agriculture. Further development of support and extension tools, drawing on the experiences of other industry sectors will however be required to assist in future uptake of EMS in agriculture.

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